JAPAN EDITED SPECIFICATIONS (JES)

FEBRUARY 2020
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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


INTERNATIONAL CODE COUNCIL (ICC)


JAPANESE INDUSTRIAL STANDARDS (JIS)


U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 03-301-01 (2019) Structural Engineering

1.2 GENERAL REQUIREMENTS

Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the prime contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

Structural observations will be performed by the Government. The contractor must provide notification to the Contracting Officer 14 days prior to the following points of construction:

a. [_____]
b. [_____]c. [_____]
1.3 DEFINITIONS

1.3.1 Continuous Special Inspections

Continuous Special Inspections is the constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

1.3.2 Periodic Special Inspections

Periodic Special Inspections is Special Inspections by the special inspector who is intermittently present where the work to be inspected has been or is being performed.

1.3.3 Perform

Perform these Special Inspections tasks for each welded joint or member, bolted or fastener connection, and required verification.

1.3.4 Observe

Observe these Special Inspections items on a random daily basis. Operations need not be delayed pending these inspections.

1.3.5 Special Inspector (SI)

A qualified person retained by the contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

1.3.6 Associate Special Inspector (ASI)

A qualified person who assists the SI in performing Special Inspections but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.

1.3.7 Third Party

A third party inspector must not be company employee of the Contractor or any Sub-Contractor performing the work to be inspected.

1.3.8 Special Inspector of Record (SIOR)

A licensed engineer in responsible charge of supervision all special inspectors for the project and approved by the Contracting officer. The SIOR must be an independent third party hired directly by the Prime Contractor.

1.3.9 Contracting Officer

The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

1.3.10 Contractor's Quality Control (QC) Manager

An individual retained by the prime contractor and qualified in accordance with the Section [01 45 00.00 10 QUALITY CONTROL] [DESIGN–BUILD Section 01}
1.3.11 Designer of Record (DOR)

A registered design professional [employed by the Government] [contracted by the Government as an A/E] responsible for the overall design and review of submittal documents prepared by others. The DOR is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in state in which the design professional works. The DOR is also referred to as the Engineer of Record (EOR) in design code documents.

1.3.12 Statement of Special Inspections (SSI)

A document developed by the DOR identifying the material, systems, components and work required to have Special Inspections.

1.3.13 Schedule of Special Inspections

A schedule which lists each of the required Special Inspections, the extent to which each Special Inspections is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17.

1.3.14 Designated Seismic System

Those nonstructural components that require design in accordance with ASCE 7 Chapter 13 and for which the component importance factor, Ip, is greater than 1.0. This designation applies to systems that are required to be operational following the Design Earthquake for RC I - IV structures [and following the MCER for RC V structures]. All systems in RC V facilities designated as MC-1 in accordance with UFC 03-301-01 are considered part of the Designated Seismic Systems. [Designated Seismic Systems will be identified by Owner and will have an Importance Factor Ip = 1.5].

1.3.15 Component Certification and O&M Manual

For any electrical or mechanical component required by ASCE 7 Section 13.2.2 to be certified, evidence demonstrating compliance with the requirement shall be maintained in a file identified as "Equipment Certification Documentation." This file shall be a part of the Operations & Maintenance Manual that is turned over to the Contracting Officer. The project specifications shall require the Operations & Maintenance Manual state that replaced or modified components need to be certified per the original certification criteria.

1.3.16 Component Identification Nameplate

Any electrical or mechanical component required by ASCE 7 SSection 13.2.2 to be certified shall bear permanent marking or nameplates constructed of a durable heat and water resistant material. Nameplates shall be mechanically attached to such nonstructural components and placed on each component for clear identification. The nameplate shall not be less than 125 x 180 with red letters 25 in height on a white background stating "Certified Equipment." The following statement shall be on the nameplate: "This equipment/component is certified. No modifications are allowed unless authorized in advance and documented in the Equipment Certification Documentation file." The nameplate shall also contain the component identification number in accordance with the drawings/specifications and
the O&M manuals.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

- SIOR Letter of Acceptance; G[, [____]]
- Special Inspections Project Manual; G[, [____]]
- Special Inspections Agency's Written Practices
- NDT Procedures and Equipment Calibration Records

SD-06 Test Reports

- Special Inspections Daily Reports
- Special Inspections Biweekly Reports

SD-07 Certificates

- Fabrication Plant Certificate of Compliance
- Special Inspector of Record Qualifications; G[, [____]]
- Special Inspector Qualifications; G[, [____]]
- Qualification Records for NDT technicians

SD-11 Closeout Submittals

- Interim Final Report of Special Inspections
- Comprehensive Final Report of Special Inspections; G[, [____]]

1.5 SPECIAL INSPECTOR QUALIFICATIONS

Submit qualifications for each special inspector [and the special inspector of record].

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<thead>
<tr>
<th>Certifying Associations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>Factory Mutual</td>
</tr>
<tr>
<td>ICC</td>
<td>International Code Council</td>
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</table>
Certifying Associations

<table>
<thead>
<tr>
<th>Certification</th>
<th>Description</th>
</tr>
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<td>JCI</td>
<td>Japan Concrete Institute</td>
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<tr>
<td>JSFA</td>
<td>Japan Steel Fabricators Association</td>
</tr>
<tr>
<td>JWES</td>
<td>Japan Welding Engineering Society</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratories</td>
</tr>
<tr>
<td>Architect Under Bldg</td>
<td>First Class Architect (Kenchikushi) Registered Under</td>
</tr>
<tr>
<td>Standard Law of Japan</td>
<td>Standard Law of Japan</td>
</tr>
</tbody>
</table>

1.5.1 Steel Construction and High Strength Bolting

1.5.1.1 Special Inspector

JSFA Certified Architectural High Strength Bolt Joint Management Engineer

1.5.2 Welding Structural Steel

1.5.2.1 Special Inspector

a. JWES Certified Welding Management Engineer

b. JSFA Certified Architectural Structural Steel Products Inspection Engineer

1.5.3 Nondestructive Testing of Welds

1.5.3.1 Special Inspector

JIS Z2305 NDT Level III Certificate.

1.5.3.2 Associate Special Inspector

JIS Z2305 NDT Level II Certificate plus one year of related experience.

1.5.4 Cold Formed Steel Framing

1.5.4.1 Special Inspector

a. JSFA Certified Architectural Structural Steel Products Inspection Engineer, or

b. Registered Professional Engineer with related experience.

1.5.5 Concrete Construction

1.5.5.1 Special Inspector

a. JCI Concrete Construction Special Inspector, or

b. Registered Professional Engineer with related experience, or

c. First Class Kenchikushi with four years of related experience.
1.5.6 Prestressed Concrete Construction

1.5.6.1 Special Inspector
  a. Registered Professional Engineer with related experience, or
  b. First Class Kenchikushi with four years of related experience

1.5.7 Post-tensioned Concrete Construction

1.5.7.1 Special Inspector
  a. Registered Professional Engineer with related experience, or
  b. First Class Kenchikushi with four years of related experience.

1.5.8 Masonry Construction

1.5.8.1 Special Inspector
  a. Registered Professional Engineer with related experience, or
  b. First Class Kenchikushi with four years of related experience.

1.5.9 Wood

1.5.9.1 Special Inspector
  a. Registered Professional Engineer with related experience
  b. First Class Kenchikushi with four years of related experience

1.5.10 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements

1.5.10.1 Special Inspector
  a. First Class Kenchikushi, or
  b. First Class Doboku Sekou Kanrigishi (1st class Civil Engineering Works Management Engineer), or
  c. Chishitsu Chosa Gishi (Professional Geotechnical Engineer).

1.5.11 Deep Foundations

1.5.11.1 Special Inspector
  Chishitsu Chosa Gishi (Professional Geotechnical Engineer)

1.5.12 Sprayed Fire Resistant Material

1.5.12.1 Special Inspector
  a. ICC Spray-applied Fireproofing Special Inspector Certificate, or
  b. ICC Fire Inspector I Certificate with one year of related experience, or
c. Registered Professional Engineer with related experience, or

d. First Class Kenchikushi with four years related experience.

1.5.13 Mastic and Intumescent Fire Resistant Coatings

1.5.13.1 Special Inspector

a. ICC Spray-applied Fireproofing Special Inspector Certificate, or

b. ICC Fire Inspector I Certificate with one year of related experience, or

c. Registered Professional Engineer with related experience, or

d. First Class Kenchikushi with four years related experience

1.5.14 Exterior Insulation and Finish System (EIFS)

1.5.14.1 Special Inspector

a. Registered Professional Engineer with related experience, or

b. First Class Kenchikushi with four years related experience.

1.5.15 Fire-Resistant Penetrations and Joints

1.5.15.1 Special Inspector

a. Passed the UL Firestop Exam with one year of related experience, or

b. Passed the FM Firestop Exam with one year of related experience, or

c. Registered Professional Engineer with related experience, or

d. First Class Kenchikushi with four years related experience.

1.5.16 Smoke Control

1.5.16.1 Special Inspector

a. AABC Technician Certification with one year of related experience, or

b. Registered Professional Engineer with related experience, or

c. First Class Kenchikushi with four years related experience

1.5.17 Architectural Components

1.5.17.1 Special Inspector

a. Registered Professional Architect with related experience, or

b. Registered Professional Engineer with related experience, or

c. First Class Kenchikushi with four years related experience.
1.5.18 Mechanical, Electrical, and Plumbing Designated Seismic Systems

1.5.18.1 Special Inspector

   a. Registered Professional Engineer with related experience, or
   b. First Class Kenchikushi with four years related experience.

[1.5.19 Special Inspector of Record (SIOR)]

Registered Professional Engineer or First Class Kenchikushi with four years of related experience.

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the following certification [certifications] to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

Minister of Land, Infrastructure and Transportation (MLIT) Certified Fabrication Plant, Category as specified

At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied and work performed by the fabricator are in accordance the construction documents.

PART 3 EXECUTION

3.1 RESPONSIBILITIES

[3.1.1 Special Inspector of Record]

   a. Supervise all Special Inspectors required by the contract documents and the IBC.
   b. Submit a SIOR Letter of Acceptance to the Contracting Officer attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR.
   c. Verify the qualifications of all of the Special Inspectors.
   d. Verify the qualifications of fabricators.
   [ e. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following:

      (1) The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.

      (2) The agency's inspection procedures, including general inspection,
material controls, and visual welding inspection.

f. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.

g. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.

h. Prepare a Special Inspections Project Manual, which will cover the following:

1. Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, General Contractor, Subcontractors, QC Manager, and DOR.

2. Organizational chart and/or communication plan, indicating lines of communication.

3. Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors.

4. Indicate the government reporting procedures.

5. Propose forms or templates to be used by SI and SIOR to document inspections.

6. Indicate procedures for tracking nonconforming work and verification that corrective work is complete.

7. Indicate how the SIOR and/or SI will participate in weekly QC meetings.

8. Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified per paragraph FABRICATOR SPECIAL INSPECTIONS.

9. Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out for each item so that the expectations are clear for the General Contractor and the Subcontractor performing the work.

Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval.

i. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party.

j. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to
allow review by the Contracting Officer and the DOR.

k. Submit a copy of the Special Inspector's daily reports to the QC Manager.

l. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.

m. Submit a biweekly Special Inspections report until all work requiring Special Inspections is complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:

(1) A brief summary of the work performed during the reporting time frame.

(2) Changes and/or discrepancies with the drawings, specifications [and mechanical or electrical component certification,] that were observed during the reporting period.

(3) Discrepancies which were resolved or corrected.

(4) A list of nonconforming items requiring resolution.

(5) All applicable test results including nondestructive testing reports.

n. At the completion of each Definable Feature of Work (DFOW) requiring Special Inspections, submit an interim final report of Special Inspections that documents the Special Inspections completed for that DFOW and corrections of all discrepancies noted in the daily reports. The interim final report of Special Inspections must be signed, dated and bear the seal of the SIOR.

o. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and bear the seal of the SIOR.

3.1.2 Quality Control Manager

a. Supervise all Special Inspectors required by the contract documents and the IBC.

b. Verify the qualifications of all of the Special Inspectors.

c. Verify the qualifications of fabricators.

d. Maintain a 3- ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the DOR.

[e.] Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.
3.1.3 Special Inspectors

a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.

b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.

c. Submit Special Inspections agency's written practices for the monitoring and control of the agency's operations to include the following:

   (1) The agency's procedures for the selection and administration of inspection personnel, describing the training, experience and examination requirements for qualifications and certification of inspection personnel.

   (2) The agency's inspection procedures, including general inspection, material controls, and visual welding inspection.

d. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.

e. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.

f. Submit a copy of the daily reports to the QC Manager.

g. Discrepancies that are observed during Special Inspections must be reported to the QC Manager for correction. If discrepancies are not corrected before the special inspector leaves the site the observed discrepancies must be documented in the daily report.

h. Submit a biweekly Special Inspection Report until all inspections are complete. A report is required for each biweekly period in which Special Inspections activity occurs, and must include the following:

   (1) A brief summary of the work performed during the reporting time frame.

   (2) Changes and/or discrepancies with the drawings, specifications [and mechanical or electrical component certification,] that were observed during the reporting period.

   (3) Discrepancies which were resolved or corrected.

   (4) A list of nonconforming items requiring resolution.

i. At the completion of each DFOW requiring Special Inspections, submit an interim final report of Special Inspections that documents the Special Inspections completed for that DFOW. Identify the inspector responsible for each item inspected and corrections of all discrepancies noted in the daily reports. The interim final report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.
j. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project and corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.

[k. Submit daily reports to the SIOR.

]3.2 DEFECTIVE WORK

Check work as it progresses, but failure to detect any defective work or materials must in no way prevent later rejection if defective work or materials are discovered, nor obligate the Contracting Officer to accept such work.

-- End of Section --
**STATEMENT OF SPECIAL INSPECTIONS**

- **Project Seismic Design Category:** E
- **Project Risk Category:** IV
- **Project Design Wind Speed (km/h):** 392
- **Number of Stories:** 2
- **Structure Height Above Grade (M):** 21

Hazardous Occupancy or attached to such? No

**Group H Occupancies (2018 IBC, Section 415)**

**Special Inspector of Record (SIOR)**

- **A Special Inspector of Record (SIOR) IS required** (per UFGS 01 45 35, Section 1.3.8)

<table>
<thead>
<tr>
<th>SIOR Name (Registered Professional):</th>
<th>John Doe P.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Registration Number:</td>
<td>0222222</td>
</tr>
<tr>
<td>Consulting Firm Name (if any):</td>
<td>ABC Structural Consulting</td>
</tr>
<tr>
<td>SIOR Office AND Mobile Phone Number:</td>
<td>1234567895 (Mobile), 123456789 (Office)</td>
</tr>
</tbody>
</table>

This Statement of Special Inspections is in accordance with Section 1704.3 of the 2018 IBC. It includes a Schedule of Special Inspections applicable to the above referenced project.

**2018 IBC 1704.3.2 and 1704.3.3**

Following is a listing of critical main wind/seismic force resisting systems for this structure. Carefully inspect these elements as part of the roles and responsibilities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

### Vertical LFRS Elements

<table>
<thead>
<tr>
<th>Elements</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary Concentric Braced Frames</td>
<td>North-South Direction Only, See Plan</td>
</tr>
<tr>
<td>Special Concentric Braced Frames</td>
<td>Lettered Gridline only, see plan for call out</td>
</tr>
<tr>
<td>Ordinary Steel Moment resisting Frames (SMRF)</td>
<td>Both orthogonal Directions, See plan for call out</td>
</tr>
<tr>
<td>Ordinary Reinforced Concrete Shearwalls</td>
<td>See Key Notes</td>
</tr>
<tr>
<td>Concrete Grade Beams Resisting Lateral Loads</td>
<td>Office Portion Only, see plan key notes</td>
</tr>
<tr>
<td>Ordinary Reinforced Masonry Shear Walls</td>
<td>High Bay, Numbered Gridlines only, see plan</td>
</tr>
<tr>
<td>OSB Sheathed Shear Walls (nailing, sill bolting, Etc)</td>
<td>See schedule on plan</td>
</tr>
<tr>
<td>Shear Wall Hold Downs</td>
<td>Identified on Plan &amp; in Detail Sheet X-XX</td>
</tr>
</tbody>
</table>

### Horizontal LFRS Elements

<table>
<thead>
<tr>
<th>Elements</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Roof Ties</td>
<td>See Key Notes on Roof Plan</td>
</tr>
<tr>
<td>Collector Elements</td>
<td>identified on plan with key notes</td>
</tr>
<tr>
<td>Concrete over metal deck</td>
<td>2nd floor and roof</td>
</tr>
<tr>
<td>Metal Roof Deck &amp; Related Fastening System</td>
<td>See Roof Plan</td>
</tr>
<tr>
<td>Out of Plane Wall Connections</td>
<td>See Structural Details XX &amp; XX</td>
</tr>
<tr>
<td>Diaphragm Cross Rod Bracing</td>
<td>See Roof Plan for locations</td>
</tr>
<tr>
<td>Cast in Place Concrete Floor and Roof Diaphragms</td>
<td>See sheet XX for details and rebar schedule</td>
</tr>
<tr>
<td>Special Force Transfer Connection</td>
<td>See Detail X on Sheet X-XX</td>
</tr>
</tbody>
</table>

Statement of Special Inspections Page 1 of 2

Japan Edited Specifications, Feb 2020
Designated Seismic Systems (DSS)
(2018 IBC 1705.13.3.4) (ASCE 7-16, 13.2.2, C13.2.2) (UFC 3-301-04, 2-11.2 & 2-13.2.2)
Non-structural 'Designated Seismic Systems' (DSS) have an $f_a$ greater than 1.0, and must be certified by the manufacturer to remain operable after a design earthquake. The Prime Contractor shall collect the manufacturers Certificates of Compliance for incorporation into the Operations and Maintenance manual per Section 01 78 23 paragraph 1.3. The SIOR shall review the Certificates of Compliance as part of the special inspection. Additionally, the below listed Designated Seismic Systems must be carefully inspected by the Special Inspector according to the requirements noted in the Schedule of Special Inspections.

### ELECTRICAL Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

1. DSS Emergency or Standby Power System
2. DSS Lighting Inverters and Associated Conduits
3. DSS Electrical System (including conduits) and Panels Serving Fire Pump Controller and Fire Pump
4. DSS Light Fixture with Emergency Battery Backup
5. DSS Component XX

If additional space is required, append an additional sheet listing the remaining DSS

### MECHANICAL/PLUMBING Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

1. DSS Gas lines and associated fittings, anchorage, & flexible connections
2. DSS Component XX
3. DSS Component XX
4. DSS Component XX
5. DSS Component XX

If additional space is required, append an additional sheet listing the remaining DSS

### OTHER Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

1. DSS Building egress stair systems
2. DSS Building fire sprinkler systems
3. DSS Elevator System, see specification section 14 21 23
4. DSS Fire pump, Fire pump controller, fire alarm control panel and mass notification
5. DSS Component XX

### Final Walk Down Inspection and Report
(UFC 3-301-01 SECTION 2-2.4.3)
Designated Seismic Systems shall receive a final walk-down inspection by the Registered Design Professional in Responsible Charge.

Final Walk Down Report, Prepared by the Registered Design Professional in Responsible Charge, Must Include:
1. Record observations of Final Walk Down Inspection
2. Document that Inspections were performed in accordance with the Schedule of Special Inspections
3. Document that all Designated Seismic Systems are installed according to construction/manufacturer document requirements, and that Compliance Certificates have been collected (UFC 3-301-01, 01, 2-13.2.2.1).
SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

PERFORM: Perform these tasks for each weld, fastener or bolted connection, and noted verification.

OBSERVE: Observe these items randomly during the course of each work day to ensure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor’s risk.

DOCUMENT: Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.

CONTINUOUS: Constant monitoring by a special inspector of identified tasks over the duration of performance of said tasks.

PERIODIC: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.

DESIGNER NOTES (to be deleted after reviewing):

1. This schedule contains minimum requirements. Do not delete applicable inspection tasks unless notes in blue indicate it is acceptable to do so.

2. Blue text = designers notes. The designer must review and edit all blue text in this schedule prior to inserting this schedule into the special inspections spec (UFGS 01 45 35).

3. Check section boxes with ANY inspection tasks applicable to your project. You may choose to delete unchecked sections or leave them in the scheduled unchecked.

4. Individual rows/tasks that that are not applicable to the project may be left in the section, as the inspector can determine whether they occur/apply (e.g. metal trusses in the light gauge framing section for example).

5. Design discipline sections are color coded for easier reference by designers. This schedule does NOT need to be printed in color.

6. When finished editing, delete this note box and save this schedule as a PDF and insert into the project specifications (special inspections section).
### A. STRUCTURAL - STEEL – WELDING SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED:** ✗

#### STEEL INSPECTION PRIOR TO WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE

*IBC 1705.2.1, AISC 360-16: Table C-N5.4-1*

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Verify that the welding procedures specification (WPS) is available</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>2. Verify manufacturer certifications for welding consumables are available</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>3. Verify material identification</td>
<td>PERFORM</td>
<td>Type and grade.</td>
</tr>
<tr>
<td>4. Welder Identification System</td>
<td>PERFORM</td>
<td>The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.</td>
</tr>
<tr>
<td>5. Fit-up of groove welds (including joint geometry)</td>
<td>OBSERVE</td>
<td>✓ Joint preparation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Dimensions (alignment, root opening, root face, bevel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Cleanliness (condition of steel surfaces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Tacking (tack weld quality and location)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Backing type and fit (if applicable)</td>
</tr>
<tr>
<td>6. Configuration and finish of access holes</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>7. Fit-up of fillet welds</td>
<td>OBSERVE</td>
<td>✓ Dimensions (alignment, gaps at root)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Cleanliness (condition of steel surfaces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Tacking (tack weld quality and location)</td>
</tr>
<tr>
<td>8. Check welding equipment</td>
<td>OBSERVE</td>
<td></td>
</tr>
</tbody>
</table>

#### STEEL INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE

*IBC 1705.2.1, AISC 360-16: Table C-N5.4-2*

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Use of qualified welders</td>
<td>PERFORM</td>
<td>Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.</td>
</tr>
<tr>
<td>10. Control and handling of welding consumables</td>
<td>OBSERVE</td>
<td>✓ Packaging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Electrode atmospheric exposure control</td>
</tr>
<tr>
<td>11. No welding over cracked tack welds</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>12. Environmental conditions</td>
<td>OBSERVE</td>
<td>✓ Wind speed within limits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Precipitation and temperature</td>
</tr>
<tr>
<td>13. Welding Procedures Specification followed</td>
<td>OBSERVE</td>
<td>✓ Settings on welding equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Travel speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Selected welding materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Shielding gas type/flow rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Preheat applied</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Interpass temperature maintained (min./max.)</td>
</tr>
</tbody>
</table>

1. **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

   **OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.

2. **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

   **OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.
### STEEL INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE

**IBC 1705.2.1, AISC 360-16: Table C-N5.4-2**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| 14. Welding techniques | OBSERVE | ✓ Interpass and final cleaning  
✓ Each pass within profile limitations  
✓ Each pass meets quality requirements  
✓ Proper position (F, V, H, OH)  
✓ Intermix of filler metals avoided |
| 15. Welds cleaned | OBSERVE |  |
| 16. Size, length, and location of all welds | PERFORM | Size, length, and location of all welds conform to the requirements of the detail drawings. |
| 17. Welds meet visual acceptance criteria | PERFORM AND DOCUMENT | ✓ Crack prohibition  
✓ Weld/base-metal fusion  
✓ Crater cross section  
✓ Weld profiles  
✓ Weld size  
✓ Undercut  
✓ Porosity |
| 18. Arc strikes | PERFORM |  |
| 19. k-area | PERFORM | When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks. |
| 20. Backing removed, weld tabs removed and finished, and fillet welds added where required | PERFORM |  |
| 21. Repair activities | PERFORM AND DOCUMENT |  |
| 22. Document acceptance or rejection of welded joint or member | PERFORM |  |
| 23. No prohibited welds have been added without the approval of the Contracting Officer | OBSERVE |  |

**CONTINUED ON FOLLOWING PAGE**

### A. STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

**STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE**

**IBC 2018 1705.2.1, AISC 360-16: Table C-N5.4-3**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Welds cleaned</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>16. Size, length, and location of all welds</td>
<td>PERFORM</td>
<td></td>
</tr>
</tbody>
</table>
| 17. Welds meet visual acceptance criteria | PERFORM AND DOCUMENT | ✓ Crack prohibition  
✓ Weld/base-metal fusion  
✓ Crater cross section  
✓ Weld profiles  
✓ Weld size  
✓ Undercut  
✓ Porosity |
| 18. Arc strikes | PERFORM |  |
| 19. k-area | PERFORM | When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks. |
| 20. Backing removed, weld tabs removed and finished, and fillet welds added where required | PERFORM |  |
| 21. Repair activities | PERFORM AND DOCUMENT |  |
| 22. Document acceptance or rejection of welded joint or member | PERFORM |  |
| 23. No prohibited welds have been added without the approval of the Contracting Officer | OBSERVE |  |

**END SECTION**

---

1 **OBSERVE**: Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.

2 **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.  

**OBSERVE**: Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.  

**DOCUMENT**: Document in a report that the work has been performed as required. This is in addition to all other required reports.
### B. STRUCTURAL - STEEL – BOLTING SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

#### STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE

**IBC 1705.2.1, AISC 360-16: Table C-N5.6-1**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manufacture’s certifications available for fastener materials</td>
<td><strong>PERFORM</strong></td>
<td></td>
</tr>
<tr>
<td>2. Fasteners marked in accordance with ASTM or JIS requirements</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>4. Proper bolting procedure selected for joint detail</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>6. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used</td>
<td><strong>PERFORM</strong></td>
<td></td>
</tr>
<tr>
<td>7. Proper storage provided for bolts, nuts, washers, and other fastener components</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE

**IBC 1705.2.1, AISC 360-16: Table C-N5.6-2**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>9. Joint brought to the snug-tight condition prior to pretensioning operation</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>10. Fastener component not turned by the wrench prevented from rotating</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
<tr>
<td>11. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges</td>
<td><strong>OBSERVE</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE

**IBC 1705.2.1, AISC 360-16: Table C-N5.6-3**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Document acceptance or rejection of all bolted connections</td>
<td><strong>DOCUMENT</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

**1** **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

**OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.

**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.
C. STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED:** ☒

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use of qualified nondestructive testing personnel</td>
<td>PERFORM</td>
<td>Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2</td>
</tr>
<tr>
<td>2. CJP groove welds</td>
<td>OBSERVE</td>
<td>[NOTE: DOR must delete this row if section D (SEISMIC PROVISIONS SECTION) is checked] Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 8mm thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.</td>
</tr>
<tr>
<td>3. Welded joints subject to fatigue</td>
<td>OBSERVE</td>
<td>Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.</td>
</tr>
<tr>
<td>4. Weld tab removal sites</td>
<td>OBSERVE</td>
<td>At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT</td>
</tr>
</tbody>
</table>

---

1 **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

1 **OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.
D. **STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION**  

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[NOTE: DOR may uncheck this section for projects NOT designed in accordance with AISC 341 (Seismic Provisions) or for projects designed according to AISC 341, but using an R value equal to 3]</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. CJP groove welds</td>
<td>OBSERVE</td>
<td>Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16” thick (8mm).</td>
</tr>
<tr>
<td>2. Beam cope and access hole.</td>
<td>OBSERVE</td>
<td>At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 38mm for rolled shapes, or when the web thickness exceeds 38mm for built-up shapes.</td>
</tr>
<tr>
<td>3. K-area NDT (AISC 341)</td>
<td>PERFORM</td>
<td>Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 75mm of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.</td>
</tr>
<tr>
<td>4. Placement of reinforcing or contouring fillet welds</td>
<td>DOCUMENT</td>
<td></td>
</tr>
</tbody>
</table>

**END SECTION**

---

1 **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.
### E. STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Placement and installation of steel headed stud anchors</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>2. Material identification of reinforcing steel (Type/Grade)</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>3. Determination of carbon equivalent for reinforcing steel other than ASTM A706</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>4. Proper reinforcing steel size, spacing, clearances, support, and orientation</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>5. Reinforcing steel has been tied and supported as required</td>
<td>OBSERVE</td>
<td></td>
</tr>
</tbody>
</table>

**END SECTION**

### F. STRUCTURAL - STEEL - OTHER INSPECTIONS

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anchor rods and other embedments supporting structural steel</td>
<td>PERFORM</td>
<td>Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.</td>
</tr>
<tr>
<td>2. Fabricated steel or erected steel frame</td>
<td>OBSERVE</td>
<td>Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.</td>
</tr>
</tbody>
</table>
| 3. Reduced beam sections (RBS) where/if occurs | DOCUMENT | ✓ Contour and finish  
 ✓ Dimensional tolerances |
| 4. Protected zones | DOCUMENT | No holes or unapproved attachments made by fabricator or erector |
| 5. H-piles where/if occurs | DOCUMENT | No holes or unapproved attachments made by the responsible contractor |

**END SECTION**

---

1. See Concrete Construction Section for all concrete related inspection of composite steel construction.

2. **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.  
**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.
G. STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

| METAL DECK INSPECTION PRIOR TO DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE |
| SDI QA/QC-2017, Appendix 1, Table 1.1 |
| **TASK** | **INSPECTION TYPE** | **DESCRIPTION** |
| 1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness | **PERFORM** |  |
| 2. Document acceptance or rejection of deck and deck accessories | **DOCUMENT** |  |

| METAL DECK INSPECTION DURING DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE |
| SDI QA/QC-2017, Appendix 1, Table 1.2 |
| **TASK** | **INSPECTION TYPE** | **DESCRIPTION** |
| 3. Verify compliance of deck and all deck accessories installation with construction documents | **PERFORM** |  |
| 4. Verify deck materials are represented by the mill certifications that comply with the construction documents | **PERFORM** |  |
| 5. Document acceptance or rejection of installation of deck and deck accessories | **DOCUMENT** |  |

| METAL DECK INSPECTION AFTER DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE |
| SDI QA/QC-2017, Appendix 1, Table 1.3 |
| **TASK** | **INSPECTION TYPE** | **DESCRIPTION** |
| 6. Welding procedure specification (WPS) available | **PERFORM** |  |
| 7. Manufactures certifications for welding consumables available | **OBSERVE** |  |
| 8. Material identification (type/grade) | **OBSERVE** |  |
| 9. Check welding equipment | **OBSERVE** |  |

END SECTION

---

1 **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

**OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.

**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.
H. STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

**METAL DECK INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE**
SDI QA/QC-2017, Appendix 1, Table 1.4 or JASS 6

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OBSERVE</td>
<td>Use of qualified welders</td>
</tr>
<tr>
<td>2.</td>
<td>OBSERVE</td>
<td>Control and handling of welding consumables</td>
</tr>
<tr>
<td>3.</td>
<td>OBSERVE</td>
<td>Environmental conditions (wind speed, moisture, temperature)</td>
</tr>
<tr>
<td>4.</td>
<td>OBSERVE</td>
<td>WPS followed</td>
</tr>
</tbody>
</table>

**METAL DECK INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE**
SDI QA/QC-2017, Appendix 1, Table 1.5 or JASS 6

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>PERFORM</td>
<td>Verify size and location of welds, including support, sidelap, and perimeter welds.</td>
</tr>
<tr>
<td>6.</td>
<td>PERFORM</td>
<td>Welds meet visual acceptance criteria</td>
</tr>
<tr>
<td>7.</td>
<td>PERFORM</td>
<td>Verify repair activities</td>
</tr>
<tr>
<td>8.</td>
<td>DOCUMENT</td>
<td>Document acceptance or rejection of welds</td>
</tr>
</tbody>
</table>

**END SECTION**

---

1 **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE**: Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.  
**DOCUMENT**: Document in a report that the work has been performed as required. This is in addition to all other required reports.
I. STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☐

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manufacturer installation instructions available for mechanical fasteners</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>2. Proper tools available for fastener installation</td>
<td>OBSERVE</td>
<td></td>
</tr>
</tbody>
</table>

METAL DECK INSPECTION BEFORE MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE
SDI QA/QC-2017, Appendix 1, Table 1.6

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Fasteners are positioned as required</td>
<td>OBSERVE</td>
<td></td>
</tr>
<tr>
<td>4. Fasteners are installed in accordance with manufacturer's instructions</td>
<td>OBSERVE</td>
<td></td>
</tr>
</tbody>
</table>

METAL DECK INSPECTION DURING MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE
SDI QA/QC-2017, Appendix 1, Table 1.7

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Check spacing, type, and installation of support fasteners</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>6. Check spacing, type, and installation of sidelap fasteners</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>7. Check spacing, type, and installation of perimeter fasteners</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>8. Verify repair activities</td>
<td>PERFORM</td>
<td></td>
</tr>
<tr>
<td>9. Document acceptance or rejection of mechanical fasteners</td>
<td>DOCUMENT</td>
<td></td>
</tr>
</tbody>
</table>

END SECTION

---

1  **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

**OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.

**DOCUMENT:** Document in a report that the work has been performed as required. This is in addition to all other required reports.
J. STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: □**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Trusses spanning 18.3m or greater where/if applies</td>
<td>PERFORM</td>
<td>Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.</td>
</tr>
</tbody>
</table>
| 2. Welded connections (seismic and/or wind resisting system) | OBSERVE         | Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs.  
[NOTE: DOR must identify critical wind and/or seismic force resisting welds in the contract drawings so that the special inspector can confirm compliance.] |
| 3. Connections (seismic and/or wind resisting system) | OBSERVE         | Visually inspect all screw attachment, bolting, anchoring and other fastening of components within the main wind or seismic force resisting system, including roof deck, roof framing, exterior wall covering, wall to roof/floor connections, braces, collectors (drag struts) and hold-downs.  
[NOTE: DOR must identify critical wind and/or seismic force resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.] |
| 4. Cold-formed steel (progressive collapse resisting system where/if applies) | OBSERVE         | Verify proper welding operations, screw attachment, bolting, anchoring and other fastening of components within the progressive collapse resisting system, including horizontal tie force elements, vertical tie force elements and bridging elements (UFC 4 023 03).  
[NOTE: DOR must identify critical progressive collapse resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.] |

**END SECTION**

K. STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: □**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| 1. Installation of open-web steel joists and joist girders | OBSERVE         | ✓ End connections – welded or bolted  
✓ All Bridging – horizontal and diagonal, per Steel Joist Institute specifications listed in Section 2207.1. |

**END SECTION**

---

1 **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
**OBSERVE:** Observe these items on a random sampling basis daily to ensure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor’s risk.
L. **STRUCTURAL - CONCRETE CONSTRUCTION SECTION**  
*THIS SECTION APPLICABLE IF BOX IS CHECKED: ✗*

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| 1. Inspect reinforcement, including prestressing tendons, and verify placement. | PERIODIC        | Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer’s instructions and/or evaluation report.  
**[NOTE: DOR must identify critical progressive collapse resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]** |
| 2. Reinforcing bar welding                                           | PERIODIC        | ✓ Verify weldability of reinforcing bars other than ASTM A 706  
✓ Inspect single-pass fillet welds, maximum 8mm in accordance with AWS D1.4 or JASS 6  
| 3. All other welding                                                 | CONTINUOUS      | Visually inspect all welds in accordance with AWS D1.4 or JASS 6  
| 4. Gas Pressure Welding                                              | CONTINUOUS      | Visually inspect all welds for compliance with construction documents and workmanship and check all welds for internal flaws by ultrasonic inspection  
| 5. Cast in place anchors and post installed drilled anchors (downward inclined) | PERIODIC        | Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.  
| 6. Post-installed adhesive anchors in horizontal or upward inclined orientations | CONTINUOUS AND DOCUMENT | ✓ Inspect as required per approved ICC-ES report  
✓ Verify that installer is certified for installation of horizontal and overhead installation applications  
✓ Inspect proof loading as required by the contract documents  
| 7. Verify use of required mix design                                 | PERIODIC        | Verify that all mixes used comply with the approved construction documents  
| 8. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete | CONTINUOUS       | At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.  

---

1 PERIODIC: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.  
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.  
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.
## STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE ¹</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Inspect concrete and/or shotcrete placement for proper application techniques</td>
<td>CONTINUOUS</td>
<td>Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.</td>
</tr>
<tr>
<td>10. Verify maintenance of specified curing temperature and technique</td>
<td>PERIODIC</td>
<td>Inspect curing, cold weather protection, and hot weather protection procedures.</td>
</tr>
<tr>
<td>11. Pre-stressed concrete</td>
<td>CONTINUOUS</td>
<td>Verify application of prestressing forces and grouting of bonded prestressing tendons.</td>
</tr>
<tr>
<td>12. Inspect erection of precast concrete members</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>13. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>14. Inspect formwork for shape, location and dimensions of the concrete member being formed.</td>
<td>PERIODIC</td>
<td></td>
</tr>
</tbody>
</table>

¹ **PERIODIC**: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.

**CONTINUOUS**: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

END SECTION
M. STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

**MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE AT START OF CONSTRUCTION**

IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE 1</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Compliance with approved submittals prior to start</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>2. Proportions of site-mixed mortar.</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>3. Grade and type of reinforcement, anchor bolts, and prestressing</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>tendons and anchorages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Prestressing technique</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>5. Properties of thin bed mortar for AAC masonry</td>
<td>PERIODIC</td>
<td></td>
</tr>
</tbody>
</table>

**MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE PRIOR TO GROUTING**

IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE 1</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Grout space</td>
<td>PERIODIC</td>
<td>[NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/III]</td>
</tr>
<tr>
<td>7. Proportions of site-prepared grout and prestressing grout for</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>bonded tendons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Proportions of site-mixed grout and prestressing grout for</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>bonded tendons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Placement of masonry units and mortar joints</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>10. Welding of reinforcement</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
</tbody>
</table>

**MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE DURING CONSTRUCTION**

IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE 1</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Size and location of structural elements is in compliance</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>12. Preparation, construction, and protection of masonry</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>during cold weather (temperature below 40°F (4.4°C) or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hot weather (temp above 90°F (32.2°C))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Application and measurement of prestressing force</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
<tr>
<td>14. Placement of grout and prestressing grout for bonded tendons</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
<tr>
<td>15. Placement of AAC masonry units and construction of thin bed</td>
<td>CONTINUOUS</td>
<td>Continuous for first 465 square meters only.</td>
</tr>
<tr>
<td>mortar joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Observe preparation of grout specimens, mortar specimens, and/or</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>prisms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Type, size and placement of reinforcement, connectors, anchor</td>
<td>PERIODIC</td>
<td>[NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/III]</td>
</tr>
<tr>
<td>bolts and prestressing tendons and anchorages, including details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of anchorage of masonry to structural members, frames, or other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>construction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

END SECTION

---

1 PERIODIC: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.
### N. STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High-load diaphragms where applicable</td>
<td>PERIODIC</td>
<td>Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.</td>
</tr>
<tr>
<td>2. Metal-plate connected wood trusses spanning 18.3m or greater</td>
<td>PERIODIC</td>
<td>Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.</td>
</tr>
</tbody>
</table>

END SECTION

### O. STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

**[NOTE: DOR may uncheck this section where sheathing nailing/fasteners (both shearwall and roof) are consistently greater than 100mm on center, or if the design wind speed is less than 49 meters/sec AND the seismic design category is A or B]**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Field gluing operation of elements of the main wind/seismic force-resisting system</td>
<td>CONTINUOUS</td>
<td>Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors, braces, hold downs, roof and floor framing connections to exterior walls.</td>
</tr>
<tr>
<td>2. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system</td>
<td>PERIODIC</td>
<td></td>
</tr>
</tbody>
</table>

END SECTION

### P. STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fabrication and installation</td>
<td>PERIODIC</td>
<td>Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer’s recommendations and approved construction documents.</td>
</tr>
</tbody>
</table>

END SECTION

---

1. **PERIODIC:** Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.

2. **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.
Q. GEOTECHNICAL - SOILS INSPECTION SECTION

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Materials below shallow foundations are adequate to achieve the design bearing capacity.</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>2. Excavations are extended to proper depth and have reached proper material</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>3. Perform classification and testing of compacted fill materials</td>
<td>PERIODIC</td>
<td></td>
</tr>
<tr>
<td>4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill</td>
<td>CONTINUOUS</td>
<td>During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report</td>
</tr>
<tr>
<td>5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.</td>
<td>PERIODIC</td>
<td></td>
</tr>
</tbody>
</table>

END SECTION

R. GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Verify element materials, sizes and lengths comply with requirements</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
<tr>
<td>2. Determine capacities of test elements and conduct additional load tests as required</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
<tr>
<td>3. Inspect driving operations and maintain complete and accurate records for each element</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
<tr>
<td>4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element</td>
<td>CONTINUOUS</td>
<td></td>
</tr>
</tbody>
</table>

END SECTION

---

1. PERIODIC: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.

2. CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.
SCHEDULE OF SPECIAL INSPECTIONS (UFGS 01 45 35)  
REVISER FOR IBC 2018  
Japan Edited Specifications, Feb 2020

S. GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED:** ☒

<table>
<thead>
<tr>
<th>HELICAL PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE</th>
<th>IBC 1705.9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TASK</strong></td>
<td><strong>DESCRIPTION</strong></td>
</tr>
<tr>
<td>1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data. The approved geotechnical report (provided upon request) and the contract documents shall be used to determine compliance</td>
<td>CONTINUOUS</td>
</tr>
</tbody>
</table>

END SECTION

T. GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED:** ☒

<table>
<thead>
<tr>
<th>CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE</th>
<th>IBC 1705.8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TASK</strong></td>
<td><strong>DESCRIPTION</strong></td>
</tr>
<tr>
<td>1. Inspect drilling operations and maintain complete and accurate records for each element.</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable and adequate end-bearing strata capacity. Record concrete or grout volumes</td>
<td>CONTINUOUS</td>
</tr>
</tbody>
</table>

END SECTION

---

1 **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.
U. FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION  
**THIS SECTION APPLICABLE IF BOX IS CHECKED: ✗**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Surface condition</td>
<td>PERIODIC</td>
<td>Prior to application confirm that surface has been prepared per the approved fire-resistance design and manufacturer’s instructions.</td>
</tr>
<tr>
<td>2. Application</td>
<td>PERIODIC</td>
<td>Prior to application confirm that the substrate meets the minimum ambient temperature per the approved fire-resistance design and manufacturer’s instructions.</td>
</tr>
<tr>
<td>3. Material thickness</td>
<td>PERIODIC</td>
<td>Verify that the thickness of the SFRM to structural elements is not less than the thickness require by the fire-resistant design in more that 10 percent of the measurement, but in no case less than minimum allowable thickness required by 1705.14.4.</td>
</tr>
<tr>
<td>4. Material density</td>
<td>PERIODIC</td>
<td>Verify that the density of the SFRM is not less than the density required by the fire-resistant design and according to IBC 1705.14.5.</td>
</tr>
<tr>
<td>5. Bond strength</td>
<td>PERIODIC</td>
<td>Verify cohesive/adhesive bond strength of the cured SFRM applied to the structural element is not less than 150psf and according to IBC 1705.14.6</td>
</tr>
</tbody>
</table>

**END SECTION**

V. FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION  
**THIS SECTION APPLICABLE IF BOX IS CHECKED: ✗**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Surface preparation</td>
<td>PERIODIC</td>
<td>Inspections shall be performed in accordance with AWCI 12-B and the contract documents</td>
</tr>
</tbody>
</table>

**END SECTION**

W. FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION  
**THIS SECTION APPLICABLE IF BOX IS CHECKED: ✗**

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.</td>
<td>PERFORM</td>
<td>[NOTE: This section applies to Risk Category III, IV, &amp; V only. DOR may choose to uncheck this section where project is assigned to Risk Category I or II. Confirm Risk Category with Structural Engineer]</td>
</tr>
<tr>
<td>2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393</td>
<td>PERFORM</td>
<td></td>
</tr>
</tbody>
</table>

**END SECTION**

---

1. **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.  
   **PERIODIC:** Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.
X.  FIRE PROTECTION – SMOKE CONTROL SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE
IBC 1705.17

<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE ¹</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Verify device locations and perform leakage testing</td>
<td>PERIODIC</td>
<td>Perform during erection of ductwork and prior to concealment</td>
</tr>
<tr>
<td>2. Pressure difference testing, flow measurements and detection and control verification</td>
<td>PERIODIC</td>
<td>Perform prior to occupancy and after sufficient completion</td>
</tr>
</tbody>
</table>

END SECTION

¹ PERIODIC: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.
Y. ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒

<p>| EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE | IBC 1705.16 |</p>
<table>
<thead>
<tr>
<th>TASK</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Water resistive barrier coating applied over a sheathing substrate.</td>
<td>PERIODIC</td>
<td>Verify that water resistive barrier coating complies with ASTM E 2570. [NOTE: not applicable to masonry or concrete wall applications. Uncheck this section in those cases]</td>
</tr>
</tbody>
</table>

END SECTION

Z. ARCHITECTURAL – ARCHITECTURAL COMPONENTS

THIS SECTION APPLICABLE IF BOX IS CHECKED: ☐

<table>
<thead>
<tr>
<th>ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE</th>
<th>IBC 1705.12.4, 1705.12.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>TASK</td>
<td>INSPECTION TYPE</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>[NOTE: This section is not applicable to Seismic Design Categories A, B, &amp; C. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with the structural engineer]</td>
<td></td>
</tr>
<tr>
<td>1. Erection and fastening of exterior cladding and interior and exterior veneer.</td>
<td>PERIODIC</td>
</tr>
<tr>
<td>2. Interior and exterior non-load bearing walls</td>
<td>PERIODIC</td>
</tr>
<tr>
<td>3. Access floors</td>
<td>PERIODIC</td>
</tr>
<tr>
<td>4. Storage racks</td>
<td>PERIODIC</td>
</tr>
<tr>
<td>5. Acoustical ceiling with 22mm wall molding and clip</td>
<td>PERIODIC</td>
</tr>
<tr>
<td>6. Acoustical ceiling with 50mm wall molding and no clip</td>
<td>PERIODIC</td>
</tr>
<tr>
<td>7. Elevator equipment, supports and seismic switch</td>
<td>PERIODIC</td>
</tr>
</tbody>
</table>

END SECTION

---

1 PERIODIC: Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.
### AA. PLUMBING/MECHANICAL DESIGNATED SEISMIC SYSTEMS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☐**

<table>
<thead>
<tr>
<th>TASK</th>
<th>TASK DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Designated Seismic Systems equipment verification</strong></td>
</tr>
<tr>
<td>2.</td>
<td><strong>Designated Seismic Systems equipment Mounting</strong></td>
</tr>
<tr>
<td>3.</td>
<td><strong>Designated Seismic Systems utility Conduit/Piping</strong></td>
</tr>
<tr>
<td>4.</td>
<td><strong>Designated Seismic Systems clearance</strong></td>
</tr>
<tr>
<td>5.</td>
<td><strong>Installation of Vibration Isolation System (Snubber)</strong></td>
</tr>
</tbody>
</table>

**PLUMBING AND MECHANICAL - DESIGNATED SEISMIC SYSTEMS**  
IBC 1705.12.4, 1705.13.3

[NOTE: This section is not applicable to Seismic Design Categories A or B. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with structural engineer]

<table>
<thead>
<tr>
<th>TASK</th>
<th>TASK DESCRIPTION</th>
</tr>
</thead>
</table>
| 1.  | **Designated Seismic Systems equipment verification**  
Checkmark **PERIODIC**  
✓ Verify model number and serial number are in conformance with project specific seismic qualification (PSSQ)  
✓ Verify Tag ID is correct and installed per specifications |
| 2.  | **Designated Seismic Systems equipment Mounting**  
Checkmark **PERIODIC**  
✓ Verify that Anchor Base Bolting is installed per PSSQ  
✓ Verify that Equipment Bracing is Installed per PSSQ  
✓ Verify that Bracing Attachments are installed per PSSQ |
| 3.  | **Designated Seismic Systems utility Conduit/Piping**  
Checkmark **PERIODIC**  
✓ Verify that Conduit/Piping is connected to the equipment per PSSQ (flex or rigid)  
✓ Verify that Conduit/Piping is seismically supported independently of equipment and in accordance with PSSQ support requirements |
| 4.  | **Designated Seismic Systems clearance**  
Checkmark **PERIODIC**  
✓ Adjacent Equipment – Verify that there is adequate gap to eliminate possibility of pounding  
✓ Conduit/Piping - Verify that there is adequate gap to eliminate possibility of pounding |
| 5.  | **Installation of Vibration Isolation System (Snubber)**  
Checkmark **PERIODIC**  
✓ Verify Anchors have been pre-qualified per ACI 355.2 and designed per ACI 318 Appendix D. |

---

1 **PERIODIC:** Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.
### BB. ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

**THIS SECTION APPLICABLE IF BOX IS CHECKED: ☒**

<table>
<thead>
<tr>
<th>ELECTRICAL - DESIGNATED SEISMIC SYSTEMS</th>
<th>INSPECTION TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| IBC 1705.12.4                           | PERIODIC        | ✔ Verify certification of emergency generator, ATS, switchgear, and control panelboard by NIPPON Engine Generator Association (NEGA)  
✔ Verify conformance with the Fire Protection Law of Standby Generator |
| 1. Generator                            |                 |             |
| 2. Automatic Transfer Switch (ATS)      | PERIODIC        | ✔ Verify certification of emergency generator, ATS, switchgear, and control panelboard by NIPPON Engine Generator Association (NEGA)  
✔ Verify conformance with the Fire Protection Law of Standby Generator |
| 3. Uninterrupted Power Source (UPS)     | PERIODIC        | ✔ Verify anchors have been pre-qualified per ACI 355.2 and designed per ACI 318 Appendix D. |
| 4. Electrical Panels                    | PERIODIC        | ✔ Verify anchors have been pre-qualified per ACI 355.2 and designed per ACI 318 Appendix D. |
| 5. Switchgear                           | PERIODIC        | ✔ Verify Anchors have been pre-qualified per ACI 355.2 and designed per ACI 318 Appendix D. |
| 6. Emergency Fixtures                   | PERIODIC        | ✔ Verify light fixtures have been installed per ASTM E580. |

### END SECTION

---

1 **PERIODIC:** Intermittent monitoring by a special inspector of identified tasks that have been or are being performed.
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1.3 SUBMITTALS
1.4 MODIFICATION OF REFERENCES
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1.6 QUALITY ASSURANCE
   1.6.1 Design Data
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   1.6.2 Shop Drawings
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   1.6.3 Control Submittals
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      1.6.3.2 Pumping Concrete
      1.6.3.3 Finishing Plan
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      1.6.3.5 Safety Data Sheets
   1.6.4 Test Reports
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      1.6.4.2 Slag Cement
      1.6.4.3 Aggregates
   1.6.5 Field Samples
      1.6.5.1 Slab Finish Sample
      1.6.5.2 Surface Finish Samples
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      2.4.3.1 Liquid Chemical Floor Hardeners and Sealers
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   2.4.5 Joint Sealants and Seals
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      2.5.2.2 Freezing and Thawing Resistance
      2.5.2.3 Corrosion and Chloride Content
      2.5.2.4 Sulfate Resistance
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      2.5.2.6 Concrete Permeability
   2.5.3 Trial Mixtures
   2.5.4 Ready-Mix Concrete
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      2.6.1.2 Bar Mats
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   2.6.3 Wire
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3.3.7 Tolerances for Form Construction
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3.4.1 PVC Waterstop
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3.4.4 Hydrophilic Waterstop

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3.5.3 Perimeter Insulation
3.5.4 Reinforcement Supports
3.5.5 Splicing
3.5.6 Future Bonding
3.5.7 Setting Miscellaneous Material
3.5.8 Fabrication
3.5.9 Placing Reinforcement
3.5.10 Spacing of Reinforcing Bars
3.5.11 Concrete Protection for Reinforcement
3.5.12 Welding

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3.7.2 Pumping
3.7.3 Cold Weather
3.7.4 Hot Weather
3.7.5 Bonding

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3.8.3 Reinforcing Steel
3.8.4 Other Waste

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3.9.3.2 As-Cast Rough Form
3.9.3.3 Standard Smooth Finish
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3.10.1.6 Pavement
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3.10.2 Flat Floor Finishes
  3.10.2.1 Measurement of Floor Tolerances
  3.10.2.2 Remedies for Out of Tolerance Work
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  3.14.2 Testing
    3.14.2.1 Slump Tests
    3.14.2.2 Temperature Tests
    3.14.2.3 Compressive Strength Tests
    3.14.2.4 Air Content
    3.14.2.5 Unit Weight of Structural Concrete
    3.14.2.6 Chloride Ion Concentration
    3.14.2.7 Strength of Concrete Structure
    3.14.2.8 Non-Conforming Materials
    3.14.2.9 Testing Concrete Structure for Strength

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  3.15.1 Crack Repair
  3.15.2 Repair of Weak Surfaces
  3.15.3 Failure of Quality Assurance Test Results

-- End of Section Table of Contents --
SECTION 03 30 00

CAST-IN-PLACE CONCRETE

02/19

PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**AMERICAN CONCRETE INSTITUTE (ACI)**

ACI 117  
(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary

ACI 301  
(2016) Specifications for Structural Concrete

ACI 302.1R  
(2015) Guide for Concrete Floor and Slab Construction

ACI 305R  

ACI SP-2  

**ASTM INTERNATIONAL (ASTM)**

ASTM A970/A970M  

ASTM C1012/C1012M  

ASTM E1155  

**JAPANESE ARCHITECTURAL STANDARD SPECIFICATIONS (JASS)**

JASS 5  
(2015) Reinforced Concrete Work

JASS 6  

**JAPANESE INDUSTRIAL STANDARDS (JIS)**

JIS A 1101  
(2014) Method of Test for Slump of Concrete

JIS A 1107  
(2014) Method of Sampling and Testing for Compressive Strength of Drilled Cores of Concrete
JIS A 1108 (2018) Method of Test for Compressive Strength of Concrete
JIS A 1115 (2014) Method of Sampling Fresh Concrete
JIS A 1116 (2005) Method of Test for Unit Mass and Air Content of Fresh Concrete by Mass Method
JIS A 1118 (2017) Method of Test for Air Content of Fresh Concrete by Volumetric Method
JIS A 1128 (2014) Method of Test for Air Content of Fresh Concrete by Pressure Method
JIS A 1132 (2014) Method of Making and Curing Concrete Specimens
JIS A 1146 (2017) Method of Test for Alkali-Silica Reactivity of Aggregates by Mortar-bar Method
JIS A 1154 (2012) Method of Test for Chloride Ion Content in Hardened Concrete
JIS A 1804 (2009) Methods of Test for Production Control of Concrete - Method of Rapid Test for Identification of Alkali-Silica Reactivity of Aggregate
JIS A 5005 (2009) Crushed Stone and Manufactured Sand for Concrete
JIS A 5011 (2013) Slag Aggregate for Concrete
JIS A 5308 (2014) Ready-Mixed Concrete
JIS A 5758 (2016) Sealants for Sealing and Glazing in Buildings
JIS A 6201 (2015) Fly Ash for Use in Concrete
JIS A 6204 (2011) Chemical Admixtures for Concrete
JIS A 8652 (1995) Metal Panels for Concrete Form
JIS A 9521 (2017) Thermal Insulation Materials for Buildings
JIS G 3101 (2017) Rolled Steels for General Structure (Amendment 1)
JIS G 3112 (2010) Steel Bars for Concrete Reinforcement
JIS G 3444 (2016) Carbon Steel Tubes for General Structure
1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, and slag cement.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Supplementary cementing materials" (SCM) include coal fly ash, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.

e. "Design strength" (f’c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.

f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 70 degrees C within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 1 meter or more regardless of temperature.

g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.

h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.

i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work
(vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

[ Concrete Curing Plan
]Quality Control Plan; G[, [_____]]
Laboratory Accreditation; G[, [_____]]

SD-02 Shop Drawings

[ Formwork
]Reinforcing Steel; G[, [_____]]

SD-03 Product Data

Formwork Materials
Reinforcement; (LEED NC)
Liquid Chemical Floor Hardeners and Sealers
Mechanical Reinforcing Bar Connectors

[ Pumping Concrete
][ Finishing Plan
]

SD-04 Samples

[ Slab Finish Sample
][ Surface Finish Samples
]

SD-05 Design Data

Concrete Mix Design; G[, [_____]]

SD-06 Test Reports

Concrete Mix Design; G[, [_____]]
Fly Ash
Pozzolan
Slag Cement

Aggregates

[ Tolerance Report ]

[ Compressive Strength Tests; G[, [____]] ]

[ Unit Weight of Structural Concrete ]

[[ Chloride Ion Concentration ]

[ Air Content ]

} Slump Tests

Water

SD-07 Certificates

Reinforcing Bars

Welder Qualifications

[ VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers ]

) Safety Data Sheets

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Liquid Chemical Floor Hardeners and Sealers

Joint Sealants; (LEED NC)

[ Curing Compound ]

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with JASS 5 and MLIT-SS Chapter 6 or ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Follow JASS 5 and MLIT-SS Chapter 6, requirements and recommendations. Do not deliver concrete until vapor retarder, [vapor barrier,] forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including [____]. Do not store concrete curing compounds or sealers in occupied spaces.
1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Design Data

1.6.1.1 Concrete Mix Design

Sixty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, supplementary cementitious materials, [fibers], and admixtures; and applicable reference specifications. Submit mill test and all other test for cement, supplementary cementitious materials, aggregates, and admixtures. Provide documentation of maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Provide mix proportion data using at least three different water-cementitious material ratios for each type of mixture, which produce a range of strength encompassing those required for each type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Resubmit data on concrete components if the qualities or source of components changes. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Reinforcing Steel

Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

1.6.3 Control Submittals

[1.6.3.1 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with JASS 5 and MLIT-SS Chapter 6.

][1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

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1.6.3.3 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish for the [_____] floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

1.6.3.4 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.3.5 Safety Data Sheets

Submit Safety Data Sheets (SDS) for all materials that are regulated for hazardous health effects. SDS must be readily accessible during each work shift to employees when they are at the construction site.

1.6.4 Test Reports

1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with JIS A 6201 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

1.6.4.2 Slag Cement

Submit test results in accordance with JIS R 5211 for slag cement. Submit test results performed within 6 months of submittal date.

1.6.4.3 Aggregates

Submit test results in accordance with JIS A 5005, JIS A 1146 and JIS A 1804 as required in the paragraph titled ALKALI-AGGREGATE REACTION.

1.6.5 Field Samples

1.6.5.1 Slab Finish Sample

Install minimum of 3000 mm by 3000 mm slab. Slab finish sample must not be part of the final project. Finish as required by specification.

1.6.5.2 Surface Finish Samples

Provide a minimum of three sample concrete panels for each finish for each mix design, 1000 mm by 1000 mm, 75 mm thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels must be representative of each of the finishes specified and of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the Contracting Officer.

1.6.6 Quality Control Plan

Develop and submit for approval a concrete quality control program in accordance with the guidelines of JASS 5 and MLIT-SS Chapter 6 and as specified herein. The plan must include approved laboratories. Provide
direct oversight for the concrete qualification program inclusive of associated sampling and testing. All quality control reports must be provided to the Contracting Officer, Quality Manager and Concrete Supplier.

1.6.7 Quality Control Personnel Certifications

The Contractor must submit for approval the responsibilities of the various quality control personnel, including the names and qualifications of the individuals in those positions and a quality control organizational chart defining the quality control hierarchy and the responsibility of the various positions. Quality control personnel must be employed by the Contractor.

Submit Japan Concrete Institute (JCI) or American Concrete Institute (ACI) certification for the following:

a. CQC personnel responsible for inspection of concrete operations.

b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews.

c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I or equivalent Japan Concrete Institute (JCI) Concrete Field Testing Technician.

1.6.7.1 Quality Manager Qualifications

The quality manager must hold a current license as a First Class Kenchikushi architect registered under standard law of Japan with experience on at least five similar projects. Evidence of extraordinary proven experience may be considered by the Contracting Officer as sufficient to act as the Quality Manager.

1.6.7.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent JCI Concrete Field Testing Technician. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.

b. Testing agencies that perform testing services on concrete materials including reinforcing steel must meet the requirements of JASS 5, JIS Q 1011, JIS Q 17011 and JIS Q 17025.

1.6.8 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of JASS 5, JIS Q 1011, JIS Q 17011 and JIS Q 17025.

1.6.9 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in
accordance with JIS Q 17011 and JIS Q 17025. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a Chief Concrete Engineer or Concrete Engineer authorized by the Japan Concrete Institute or First Class Kenchikushi who is competent in concrete materials and must sign all reports and designs.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by JIS A 1132.

c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to material manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing period or for 72 hours after installation:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 13 degrees C and 29 degrees C and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

a. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.

b. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with JASS 6.

Verify that Welder qualifications are in accordance with JIS Z 3881 for welding of reinforcement or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.
PART 2   PRODUCTS

2.1   FORMWORK MATERIALS

a. Form-facing material in contact with concrete must be [lumber,] [plywood,] [tempered concrete-form-grade hardboard,] [metal,] [plastic,] or [treated paper that creates specified appearance and texture of concrete surface]. Submit product information on proposed form-facing materials if different from that specified herein.

b. Design formwork, shores, reshores, and backshores to support all vertical and lateral loads transmitted to them and to comply with applicable building code requirements.

c. Design formwork and shoring for load redistribution resulting from stressing of post-tensioned reinforcement. Ensure that formwork allows movement resulting from application of prestressing force.

d. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

e. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.

f. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.

g. Design formwork joints to inhibit leakage of mortar.

h. Limit deflection of facing materials for concrete surfaces exposed to view to [1/240][1/400][____] of center-to-center spacing of facing supports.

i. Do not use earth cuts as forms for vertical or sloping surfaces.

j. Submit product information on proposed form-facing materials if different from that specified herein.

k. Submit shop drawings for formwork, shoring, reshoring, and backshoring. Shop drawings must be signed and sealed by a licensed design engineer or First Class Kenchikushi.

l. Submit procedure for reshoring and backshoring, including drawings signed and sealed by a First Class Kenchikushi. Include on shop drawings the formwork removal procedure and magnitude of construction loads used for design of reshoring or backshoring system. Indicate in procedure the magnitude of live and dead loads assumed for required capacity of the structure at time of reshoring or backshoring.

m. Submit manufacturer's product data on form liner proposed for use with each formed surface.

2.1.1   Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with Japan Agricultural Standard concrete form panels or better or hardboard for smooth form lining.[ Submit data verifying that composite wood products contain no urea formaldehyde resins.]
2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to Japan Agricultural Standard concrete form, not less than 16 mm thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to Japan Agricultural Standard high density form overlay, not less than 16 mm thick.

2.1.2 Steel Forms

Provide JIS A 8652 steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

a. Use commercially manufactured formwork accessories, including ties and hangers.

b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

a. Use form ties with ends or end fasteners that can be removed without damage to concrete.

b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.

c. The breakback distance for ferrous ties must be at least [50 mm] [19 mm ] [_____] for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.

[ d. If the breakback distance is less than 19 mm, use coated or corrosion-resistant ties.

] e. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to JIS K 6773.

2.2.2.2 Rubber Waterstop

Rubber waterstops must conform to JIS K 6773.

2.2.2.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to JIS K 6258.
2.2.2.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to the following requirements when tested in accordance to JIS K 6251: Tensile strength 2.9 MPa minimum; ultimate elongation 600 percent minimum. Hardness must be 50:40 minimum on the type A durometer when tested in accordance with JIS K 6253 and the volumetric expansion ratio in distilled water at 20 degrees C must be 3 to 1 minimum.

2.2.3 Biodegradable Form Release Agent

a. Provide form release agent that is colorless, biodegradable, and [rapeseed oil-based] [soy oil-based] [water-based], with a [low (maximum of 55 grams/liter (g/l))] [zero] VOC content. A minimum of [85][_____] percent of the total product must be biobased material.

b. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

c. Provide form release agent that reduces formwork moisture absorption, and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

d. Submit manufacturer's product data on formwork release agent for use on each form-facing material.

2.2.4 Chamfer Materials

Use lumber materials with dimensions of 20 x 20 mm.

2.2.5 Construction and movement joints

a. Submit details and locations of construction joints in accordance with the requirements herein.

b. Locate construction joints within middle one-third of spans of slabs, beams, and girders. If a beam intersects a girder within the middle one-third of girder span, the distance between the construction joint in the girder and the edge of the beam must be at least twice the width of the larger member.

c. For members with post-tensioning tendons, locate construction joints where tendons pass through centroid of concrete section.

d. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.

e. Make construction joints perpendicular to main reinforcement.

f. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.

g. Submit location and detail of movement joints if different from those indicated in Contract Documents.
h. Submit manufacturer's data sheet on expansion joint materials.

i. Provide keyways where indicated in Contract Documents. [Longitudinal keyways indicated in Contract Documents must be at least 40 mm deep, measured perpendicular to the plane of the joint.]

2.2.6 Perimeter Insulation

Perimeter insulation must be expanded polystyrene conforming to JIS A 9521 meeting the following performance requirements:

a. Density: 300 kg/m³ minimum.

b. Compressive Strength at yield or 10 percent deformation: 104 kPa, min.

c. Thermal Resistance of 25 mm thickness: 0.70 K⋅m²/W

d. Flexural Strength: 240 kPa, min.

e. Water Absorption by total immersion, volume percent: 3 percent maximum.

f. Dimensional Stability (change in dimensions): 2 percent maximum.

g. Water Vapor Permeance of 25 mm thickness: 200 ng/Pa⋅s⋅m², maximum.

Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING

2.2.7 Other Embedded items

Use sleeves, inserts, anchors, and other embedded items of material and design indicated in Contract Documents.

2.3 CONCRETE MATERIALS

2.3.1 Cementitious Materials

2.3.1.1 Portland Cement

a. Unless otherwise specified, provide cement that conforms to JIS R 5210, Ordinary Portland Cement [and meets [low alkali content requirements] [_____].]

b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

c. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.

d. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.1.2 Blended Cements

Blended cements must conform to [JIS R 5211, Type [A] [B] [C]], [JIS R 5212,
2.3.2 Water

a. Water or ice must comply with the requirements of JIS A 5308, Annex C.

b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.

c. Water must be [potable] [from rainwater collection] [from graywater] [from recycled water]; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

d. Protect mixing water and ice from contamination during storage and delivery.

e. Submit test report showing water complies with JIS A 5308, Annex C.

f. When nonpotable source is proposed for use, submit documentation on effects of water on strength and setting time in compliance with JIS A 5308, Annex C.

2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

a. Aggregates must conform to JIS A 5005 [unless otherwise specified in the Contract Documents or approved by the contracting officer][____].

b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.

c. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.

d. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with JIS A 5005 and JIS A 1804 expansion data not more than 18 months old.

2.3.4 Admixtures

a. Chemical admixtures must conform to JIS A 6204.

b. Air-entraining admixtures must conform to JIS A 6204.

c. Chemical admixtures for use in producing flowing concrete must conform to JIS A 6204.

d. Do not use calcium chloride admixtures[.][ unless approved by the contracting officer.]

e. Admixtures used in concrete must be the same as those used in the concrete represented by submitted field test records or used in trial mixtures.
f. Protect stored admixtures against contamination, evaporation, or damage.

g. To ensure uniform distribution of constituents, provide agitating equipment for admixtures used in the form of suspensions or unstable solutions. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.

h. Submit types, brand names, producers' names, manufacturer's technical data sheets, and certificates showing compliance with standards required herein.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete Curing Materials

Provide concrete curing material in accordance with JASS 5 and MLIT-SS Chapter 6. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

2.4.2 Nonshrink Grout

Packaged dry, hydraulic cement non-shrink grout, that is non-metallic, non-corrosive, non-bleed, with the following performance requirements when prepared using the highest water-to-solids ratio, maximum flow, or most fluid consistency at 23.0 plus or minus 2.0 degrees C:

a. Minimum compressive strengths: 7.0 MPa at 1 day; 17.0 MPa at 3 day; 24.0 MPa at 7 day; and 34.0 MPa at 28 day.

b. Early height change (maximum percent at time of final setting): plus 4.0 percent.

c. Height change of moist cured hardened grout: 0.0 to plus or minus 0.3 percent at 1-day, 3-day, 14-day and 28-day.

2.4.3 Floor Finish Materials

2.4.3.1 Liquid Chemical Floor Hardeners and Sealers

a. Hardener must be a colorless aqueous solution containing a blend of inorganic silicate or siliconate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.

b. Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content. Submit manufactures instructions for placement of sealers.

2.4.4 Expansion/Contraction Joint Filler

Preformed, bituminous joint fiber filler for concrete paving and structural concrete construction. Provide joint filler meeting the following performance requirements:

a. Density: 300 kg/m³ minimum.

b. Compression: The load required to compress the test specimen to 50
percent of its thickness before test shall not be less than 690 kPa and not more than 5100 kPa. If the nominal thickness of the specimen is less than 13 mm a maximum load of 8600 kPa is permitted.

c. Extrusion/Protrusion: Test specimen shall be compressed to 50 percent of its thickness before test with three edges restrained. The amount of extrusion/protrusion of the free edge shall not exceed 6 mm.

d. Recovery: The test specimen shall be compressed to 50 percent of its thickness before test. The load shall be released immediately after application. At the end of 10 minutes after release of the applied load, the specimen shall have recovered to at least 70 percent of its thickness before test.

e. Water Absorption: The test specimen when submerged under 25 mm of water shall absorb not more than 15 percent by volume in 24 hours for 10 mm thickness and over.

Material must be 13 mm thick[, unless otherwise indicated]. [and of a width applicable for the joint formed]. [Backer material shall be closed cell, polyethylene foam material with a density between 20-45 kg/m³; Greater than 95 percent compression recovery; compression deflection 38 kPa; Greater than 160kPa tensile strength; and 200 degrees C heat resistance for hot applied sealants].

### 2.4.5 Joint Sealants and Seals

[ Submit manufacturer's product data, indicating VOC content.] [Joint sealants conforming to the requirements of Section 07 92 00 JOINT SEALANTS].

#### 2.4.5.1 Horizontal Surfaces, 3 Percent Slope, Maximum

JIS A 5758, multi-component sealant, Class 25, traffic [non-traffic].
[Hot-applied joint sealant for sealing cracks in concrete and asphalt pavements shall be in conformance with the applicable requirements of the JRA PDCG - Pavement Design and Construction Guidelines.]

#### 2.4.5.2 Vertical Surfaces Greater Than 3 Percent Slope

JIS A 5758, multi-component sealant, non-sag, Class 25, traffic [non-traffic].

#### 2.4.6 Vapor Retarder [and Vapor Barrier]

Preformed, flexible polyethylene sheeting to be used as vapor retarder in contact with soil or granular fill under concrete slabs, minimum 0.25 mm [0.38 mm] thickness or other equivalent material meeting the following performance requirements:

a. Water Vapor Permeance, JIS K 7129-2 or equivalent test procedure: 2.28 ng/(m²·s ·Pa), max.

b. Water Vapor Permeance after wetting, drying and soaking [, after heat conditioning] [, after low temperature conditioning] [, after soil organism conditioning], JIS K 7129-2 or equivalent test procedure: 2.28 ng/(m²·s ·Pa), max.

c. Tensile Strength, JIS K 7127: 2.4 kN/m [5.3 kN/m] [7.9 kN/m], min.
d. Puncture Resistance, JIS K 7124-1: 475 g [1700 g] [2200 g], min.

[Preformed, flexible polyethylene sheeting to be used as vapor barrier in contact with soil or granular fill under concrete slabs, minimum 0.38 mm thickness or other equivalent material with the following performance requirements:

a. Water Vapor Permeance, JIS K 7129-2 or equivalent test procedure: 0.57 ng/(m²·s·Pa), max.

b. Water Vapor Permeance after wetting, drying and soaking [, after heat conditioning] [, after low temperature conditioning] [, after soil organism conditioning], JIS K 7129-2 or equivalent test procedure: 0.57 ng/(m²·s·Pa), max.

c. Tensile Strength, JIS K 7127: 7.9 kN/m, min.

d. Puncture Resistance, JIS K 7124-1: 2200 g, min.]

Consider plastic vapor retarders and vapor barriers and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

a. Use materials and material combinations listed in this section and the contract documents.

b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents.

[The minimum cementitious material content for concrete used in floors must meet the following requirements:

<table>
<thead>
<tr>
<th>Nominal maximum size of aggregate, mm</th>
<th>Minimum cementitious material content, kg per cubic meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>280</td>
</tr>
<tr>
<td>25</td>
<td>310</td>
</tr>
<tr>
<td>19</td>
<td>320</td>
</tr>
<tr>
<td>9.5</td>
<td>360</td>
</tr>
</tbody>
</table>
]

c. Selected target slump must meet the requirements this section, the contract documents, and must not exceed 230 mm. Concrete must not show visible signs of segregation.

d. The target slump must be enforced for the duration of the project. Determine the slump by JIS A 1101. Slump tolerances must meet the requirements of JASS 5 and MLIT-SS Chapter 6.

e. The nominal maximum size of coarse aggregate for a mixture must not
exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

f. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must be in accordance with the requirements of the paragraph titled DURABILITY.

g. Measure air content at the point of delivery in accordance with JIS A 1118 or JIS A 1128.

h. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total air content greater than 3 percent.

i. Concrete properties and requirements for each portion of the structure are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

<table>
<thead>
<tr>
<th></th>
<th>Minimum ( f'c ) MPa</th>
<th>Exposure Categories</th>
<th>Miscellaneous Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Footings</strong></td>
<td>[36] [21] [_____]</td>
<td>[S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3]</td>
<td>[Max. slump: [15 cm] [_____] ]</td>
</tr>
<tr>
<td></td>
<td>at 28 days</td>
<td></td>
<td>[Nominal maximum aggregate size must be [12.5 mm][19 mm][25 mm][_____] ]</td>
</tr>
<tr>
<td><strong>Columns and walls</strong></td>
<td>[36] [21] [_____]</td>
<td>[S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3]</td>
<td>[Nominal maximum aggregate size must be [12.5 mm][19 mm][25 mm][_____] ]</td>
</tr>
<tr>
<td></td>
<td>at 28 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Beams and elevated slabs</strong></td>
<td>[36] [21] [_____]</td>
<td>[S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3]</td>
<td>[Nominal maximum aggregate size must be [12.5 mm][19 mm][25 mm][_____] ]</td>
</tr>
<tr>
<td></td>
<td>at 28 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Slabs-on-ground</strong></td>
<td>[36] [21] [_____]</td>
<td>[S0] [S1] [S2] [S3]; [C0] [C1] [C2]; [W0] [W1]; [F0] [F1] [F2] [F3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at 28 days</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR) to reduce the potential of alkali-silica reaction (ASR). For each aggregate used in qualifying concrete mixtures, the expansion result of the aggregate and cementitious materials combination determined in accordance with JIS A 1146 must not exceed 0.10 percent at an age of 16 days.

2.5.2.2 Freezing and Thawing Resistance

a. Provide concrete meeting the following requirements based on exposure class assigned to members for freezing-and-thawing exposure in Contract Documents:

<table>
<thead>
<tr>
<th>Exposure class</th>
<th>Maximum (w/cm^2)</th>
<th>Minimum (f'c, \text{MPa})</th>
<th>Air content</th>
<th>Additional Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>N/A</td>
<td>18</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>0.55</td>
<td>24</td>
<td>Depends on aggregate size</td>
<td>N/A</td>
</tr>
<tr>
<td>F2</td>
<td>0.45</td>
<td>30</td>
<td>Depends on aggregate size</td>
<td>See limits on maximum cementitious material by mass</td>
</tr>
<tr>
<td>F3</td>
<td>0.40</td>
<td>36</td>
<td>Depends on aggregate size</td>
<td>See limits on maximum cementitious material by mass</td>
</tr>
<tr>
<td>F3 plain concrete</td>
<td>0.45</td>
<td>30</td>
<td>Depends on aggregate size</td>
<td>See limits on maximum cementitious material by mass</td>
</tr>
</tbody>
</table>

*The maximum \(w/cm\) limits do not apply to lightweight concrete.

b. Concrete must be air entrained for members assigned to Exposure Class
F1, F2, or F3. The total air content must meet the requirements of the following table:

<table>
<thead>
<tr>
<th>Nominal maximum aggregate size, mm</th>
<th>Total air content, percent**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exposure Class F2 and F3</td>
</tr>
<tr>
<td>9.5</td>
<td>7.5</td>
</tr>
<tr>
<td>12.5</td>
<td>7.0</td>
</tr>
<tr>
<td>19.0</td>
<td>6.0</td>
</tr>
<tr>
<td>25.0</td>
<td>6.0</td>
</tr>
<tr>
<td>37.5</td>
<td>5.5</td>
</tr>
<tr>
<td>50</td>
<td>5.0</td>
</tr>
<tr>
<td>75</td>
<td>5.5</td>
</tr>
</tbody>
</table>

*Tolerance on air content as delivered must be plus/minus 1.5 percent.
^For f'c greater than 36 MPa psi, reducing air content by 1.0 percentage point is acceptable.

c. Submit documentation verifying compliance with specified requirements.
d. For sections of the structure that are assigned Exposure Class F3, submit certification on cement composition verifying that concrete mixture meets the requirements of the following table:

<table>
<thead>
<tr>
<th>Cementitious material</th>
<th>Maximum percent of total cementitious material by mass*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly ash or other pozzolans conforming to JIS A 6201</td>
<td>25</td>
</tr>
<tr>
<td>Slag cement conforming to JIS A 5011</td>
<td>50</td>
</tr>
</tbody>
</table>

*Total cementitious material also includes JIS R 5210, fly ash, other pozzolans, and slag cement. The maximum percentages above must include:

i. Fly ash or other pozzolans present in Type IP JIS R 5212 blended cement.

ii. Slag cement present in Type IS JIS R 5211 blended cement.

^Fly ash or other pozzolans must constitute no more than 25 percent of the total mass of the cementitious materials.

2.5.2.3 Corrosion and Chloride Content

a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members requiring protection against
reinforcement corrosion in Contract Documents.

b. Submit documentation verifying compliance with specified requirements.

c. Water-soluble chloride ion content contributed from constituents including water, aggregates, cementitious materials, and admixtures must be determined for the concrete mixture by JIS A 1154 at age between 28 and 42 days.

d. The maximum water-soluble chloride ion (Cl-) content in concrete, percent by mass of cement is as follows:

<table>
<thead>
<tr>
<th>Exposure class</th>
<th>Maximum w/cm*</th>
<th>Minimum f', MPa</th>
<th>Maximum water-soluble chloride ion (Cl-) content in concrete, percent by mass of cement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reinforced concrete</td>
</tr>
<tr>
<td>C0</td>
<td>N/A</td>
<td>18</td>
<td>1.00</td>
</tr>
<tr>
<td>C1</td>
<td>N/A</td>
<td>18</td>
<td>0.30</td>
</tr>
<tr>
<td>C2</td>
<td>0.4</td>
<td>36</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Prestressed concrete</td>
</tr>
<tr>
<td>C0</td>
<td>N/A</td>
<td>18</td>
<td>0.06</td>
</tr>
<tr>
<td>C1</td>
<td>N/A</td>
<td>18</td>
<td>0.06</td>
</tr>
<tr>
<td>C2</td>
<td>0.4</td>
<td>36</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*The maximum w/cm limits do not apply to lightweight concrete.

2.5.2.4 Sulfate Resistance

a. Provide concrete meeting the requirements of the following table based on the exposure class assigned to members for sulfate exposure.

<table>
<thead>
<tr>
<th>Exposure class</th>
<th>Maximum w/cm*</th>
<th>Minimum f', MPa</th>
<th>Required cementitious materials-types</th>
<th>Calcium chloride admixture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>JIS R 5210, JIS R 5212</td>
<td>No restrictions</td>
</tr>
<tr>
<td>S0</td>
<td>N/A</td>
<td>17</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Exposure class</td>
<td>Maximum w/cm*</td>
<td>Minimum f'c MPa</td>
<td>Required cementitious materials-types</td>
<td>Calcium chloride admixture</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------</td>
<td>-----------------</td>
<td>--------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>S1</td>
<td>0.50</td>
<td>28</td>
<td>II (moderate sulfate resistant)**</td>
<td>No restrictions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IP, portland pozzolan cement (moderate sulfate resistant); IS, portland blast furnace slag cement (&lt;70) (moderate sulfate resistant)</td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>0.45</td>
<td>31</td>
<td>IV (low heat of hydration)**</td>
<td>Not permitted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IP, portland pozzolan cement (high sulfate resistant); IS, portland blast furnace slag cement (&lt;70) (high sulfate resistant)</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>0.45</td>
<td>31</td>
<td>V (high sulfate resistant) + pozzolan or slag cement **</td>
<td>Not permitted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IP, portland pozzolan cement (high sulfate resistant) + pozzolan or slag cement; IS, portland blast furnace slag cement (&lt;70) (high sulfate resistant) + pozzolan or slag cement *</td>
<td></td>
</tr>
</tbody>
</table>

* For seawater exposure, other types of portland cements with tricalcium aluminate (C3A) contents up to 10 percent are acceptable if the w/cm does not exceed 0.40.

** The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag used shall not be less than the amount tested in accordance with ASTM C1012/C1012M and meeting the requirements maximum expansion requirements listed herein.

^ Other available types of cement, such as Type III or Type I, are acceptable in exposure classes S1 or S2 if the C3A contents are less than 8 or 5 percent, respectively.

b. The maximum w/cm limits for sulfate exposure do not apply to
lightweight concrete.

c. Alternative combinations of cementitious materials of those listed in this paragraph are acceptable if they meet the maximum expansion requirements listed in the following table:

<table>
<thead>
<tr>
<th>Exposure class</th>
<th>Maximum expansion when tested using ASTM C1012/C1012M</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At 6 months</td>
</tr>
<tr>
<td>S1</td>
<td>0.10 percent</td>
</tr>
<tr>
<td>S2</td>
<td>0.05 percent</td>
</tr>
<tr>
<td>S3</td>
<td>N/A</td>
</tr>
</tbody>
</table>

^The 12-month expansion limit applies only when the measured expansion exceeds the 6-month maximum expansion limit.

2.5.2.5 Concrete Temperature

The temperature of concrete as delivered must not exceed [35 degrees C] [______].

2.5.2.6 Concrete Permeability

a. Provide concrete meeting the requirements of the following table based on exposure class assigned to members requiring low permeability in the Contract Documents.

<table>
<thead>
<tr>
<th>Exposure class</th>
<th>Maximum w/cm*</th>
<th>Minimum f',c, MPa</th>
<th>Additional minimum requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0</td>
<td>N/A</td>
<td>18</td>
<td>None</td>
</tr>
<tr>
<td>W1</td>
<td>0.5</td>
<td>27</td>
<td>None</td>
</tr>
</tbody>
</table>

*The maximum w/cm limits do not apply to lightweight concrete.

b. Submit documentation verifying compliance with specified requirements.

2.5.3 Trial Mixtures

Trial mixtures must be in accordance to JASS 5 and MLIT-SS Chapter 6.

2.5.4 Ready-Mix Concrete

Provide concrete that meets the requirements of JIS A 5308.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by JIS A 5308:

a. Type and brand cement
b. Cement and supplementary cementitious materials content in 43-kilogram bags per cubic meter of concrete

c. Maximum size of aggregate

d. Amount and brand name of admixtures

e. Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

a. Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of JASS 5 and MLIT-SS Chapter 6.

b. When handling and storing coated reinforcement, use equipment and methods that do not damage the coating. If stored outdoors for more than 2 months, cover coated reinforcement with opaque protective material.

c. Submit manufacturer's certified test report for reinforcement.

d. Submit placing drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports. Placing drawings must indicate locations of splices, lengths of lap splices, and details of mechanical and welded splices.

e. Submit request with locations and details of splices not indicated in Contract Documents.

f. Submit request to place column dowels without using templates.

[g. Submit request and procedure to field-bend or straighten reinforcing bars partially embedded in concrete at locations not indicated in Contract Documents. Field bending or straightening of reinforcing bars is permitted [where indicated in the Contract Documents][in the following locations: [_____]]]

h. Submit request for field cutting, including location and type of bar to be cut and reason field cutting is required.

2.6.1 Reinforcing Bars

a. Reinforcing bars must be deformed, except spirals, load-transfer dowels, and welded wire reinforcement, which may be plain.

b. JIS G 3112, grades and sizes as indicated. [Cold drawn wire used for spiral reinforcement must conform to JIS G 3551.]

[Provide reinforcing bars that contain a minimum of [100][_____] percent recycled content.][ See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements.]

c. [Reinforcing bars may contain post-consumer or post-industrial recycled content.][Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.]

d. Submit mill certificates for reinforcing bars.
2.6.1.1 Headed Reinforcing Bars

Headed reinforcing bars must conform to ASTM A970/A970M including Annex A1, and other specified requirements.

2.6.1.2 Bar Mats

a. Bar mats must conform to JIS G 3551.

2.6.2 Mechanical Reinforcing Bar Connectors

a. Provide 125 percent minimum yield strength of the reinforcement bar.

b. Mechanical splices for galvanized reinforcing bars must be galvanized or coated with dielectric material.

c. Mechanical splices used with epoxy-coated or dual-coated reinforcing bars must be coated with dielectric material.

d. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Wire

a. [Provide wire reinforcement that contains a minimum of [100] [_____] percent recycled content.][See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements. Wire reinforcement may contain post-consumer or post-industrial recycled content. ]Provide flat sheets of welded wire reinforcement for slabs and toppings.

b. Plain or deformed steel wire must conform to JIS G 3551.

2.6.4 Welded Wire Reinforcement

a. Use welded wire reinforcement specified in Contract Documents and conforming to one or more of the specifications given herein.

b. Plain welded wire reinforcement must conform to JIS G 3551, with welded intersections spaced no greater than 300 mm apart in direction of principal reinforcement.

c. Deformed welded wire reinforcement must conform to JIS G 3551, with welded intersections spaced no greater than 400 mm apart in direction of principal reinforcement.

d. Zinc-coated (galvanized) welded wire reinforcement must conform to JIS H 8641. Coating damage incurred during shipment, storage, handling, and placing of zinc-coated (galvanized) welded wire reinforcement must be repaired in accordance with JASS 6. If damaged area exceeds 2 percent of surface area in each linear foot of each wire or welded wire reinforcement, the sheet containing the damaged area must not be used. The 2 percent limit on damaged coating area shall include repaired areas damaged before shipment.

2.6.5 Reinforcing Bar Supports

a. Provide reinforcement support types within structure as required by
Reinforcement supports must conform to JASS 5 and MLIT-SS Chapter 6.

b. Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

c. [Minimum [5][10][_____] percent post-consumer recycled content, or minimum [20][40][_____] percent post-industrial recycled content. ] [See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total recycled content requirements. Plastic and steel may contain post-consumer or post-industrial recycled content.]

2.6.6 Dowels for Load Transfer in Floors

Provide greased dowels for load transfer in floors of the type, design, weight, and dimensions indicated. Provide dowel bars that are plain-billet steel conforming to JIS G 3112, Grade SD295. Provide dowel pipe that is steel conforming to JIS G 3444 STK400.

[Plate dowels must conform to JIS G 3101 SS400, and must be of size and spacing indicated. Plate dowel system must minimize shrinkage restraint by [using a tapered shape] [or] [formed void] [or] [by having compressible material on the vertical faces with a thin bond breaker on the top and bottom dowel surfaces.]

2.6.7 Welding

a. Provide weldable reinforcing bars that conform to JIS G 3112, grades and sizes as indicated. The maximum carbon content shall not exceed 0.55 percent with carbon not exceeding 0.30 percent and manganese not exceeding 1.5 percent.

b. Comply with JIS Z 3881 unless otherwise specified. Do not tack weld reinforcing bars.

c. Welded assemblies of steel reinforcement produced under factory conditions, such as welded wire reinforcement, bar mats, and deformed bar anchors, are allowed.

PART 3 EXECUTION

3.1 EXAMINATION

a. Do not begin installation until substrates have been properly constructed; verify that substrates are level.

b. If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.

c. Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before
the concrete is poured.

3.2.1 General

a. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

b. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

a. When subgrade material is semi-porous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder.

b. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

3.2.3 Subgrade Under Slabs on Ground

a. Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

b. Previously constructed subgrade or fill must be cleaned of foreign materials

c. Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 6 mm when tested with a 3000 mm straightedge parallel with and at right angles to building lines.

d. Finished surface of subgrade or fill under exterior slabs on ground must not be more than 6 mm above or 30 mm below elevation indicated.

3.2.4 Edge Forms and Screed Strips for Slabs

a. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.

b. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.5 Reinforcement and Other Embedded Items

a. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

b. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.
3.3 FORMS

a. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade.

b. Chamfer above grade exposed joints, edges, and external corners of concrete [20 mm]. Place chamfer strips in corners of formwork to produce beveled edges on permanently exposed surfaces.[ Do not bevel reentrant corners or edges of formed joints of concrete.]

c. Provide formwork with clean-out openings to permit inspection and removal of debris.

d. Inspect formwork and remove foreign material before concrete is placed.

e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.

f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.

g. Fasten form wedges in place after final adjustment of forms and before concrete placement.

h. Provide anchoring and bracing to control upward and lateral movement of formwork system.

i. Construct formwork for openings to facilitate removal and to produce opening dimensions as specified and within tolerances.

j. Provide runways for moving equipment. Support runways directly on formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of formwork or structural members.

k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.

l. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete placement.

3.3.1 Coating

a. Cover formwork surfaces with an acceptable material that inhibits bond with concrete.

b. If formwork release agent is used, apply to formwork surfaces in accordance with manufacturer's recommendations before placing reinforcement. Remove excess release agent on formwork prior to concrete placement.

c. Do not allow formwork release agent to contact reinforcement or
hardened concrete against which fresh concrete is to be placed.

3.3.2 Reshoring

a. Do not allow structural members to be loaded with combined dead and construction loads in excess of loads indicated in the accepted procedure.

b. Install and remove reshores or backshores in accordance with accepted procedure.

c. For floors supporting shores under newly placed concrete, either leave original supporting shores in place, or install reshores or backshores. Shoring system and supporting slabs must resist anticipated loads. Locate reshores and backshores directly under a shore position or as indicated on formwork shop drawings.

d. In multistory buildings, place reshoring or backshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads.

3.3.3 Reuse

a. Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

b. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.

c. Remove leaked mortar from formwork joints before reuse.

3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with JASS 5 and MLIT-SS Chapter 6 with a surface finish, ACI 301 SF-1.0, for formed surfaces that are to be concealed by other construction.

3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with JASS 5 and MLIT-SS Chapter 6 with a surface finish, ACI 301 SF-3.0, for formed surfaces that are exposed to view.

[ Do not provide mockup of concrete surface appearance and texture.]

3.3.6 Form Ties

a. For post-tensioned structures, do not remove formwork supports until stressing records have been accepted by the Contracting Officer.

b. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with JASS 5 and MLIT-SS Chapter 6.

3.3.7 Tolerances for Form Construction

a. Construct formwork so concrete surfaces conform to tolerances in JASS 5 and MLIT-SS Chapter 6.

b. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within JASS 5 and MLIT-SS Chapter 6 tolerances.
c. To maintain specified elevation and thickness within tolerances, install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.

3.3.8 Removal of Forms and Supports

a. If vertical formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.

b. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform repairs and finishing operations required. If forms are removed before end of specified curing period, provide curing and protection.

c. Do not damage concrete during removal of vertical formwork for columns, walls, and sides of beams. Perform needed repair and finishing operations required on vertical surfaces. If forms are removed before end of specified curing period, provide curing and protection.

[ d. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place required strength of concrete is reached.

] e. Form-facing material and horizontal facing support members may be removed before in-place concrete reaches specified compressive strength if shores and other supports are designed to allow facing removal without deflection of supported slab or member.

3.3.9 Strength of Concrete Required for Removal of Formwork

If removal of formwork, reshoring, or backshoring is based on concrete reaching a specified in-place strength, mold and field-cure cylinders in accordance with JIS A 1132. Test cylinders in accordance with JIS A 1108.

3.4 WATERSTOP INSTALLATION AND SPLICES

a. Provide waterstops in construction joints as indicated.


c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a
remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to JASS 5 and MLIT-SS Chapter 6. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.

b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

<table>
<thead>
<tr>
<th>Concrete Exposure</th>
<th>Member</th>
<th>Reinforcement</th>
<th>Specified cover, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast against and permanently in contact with ground</td>
<td>All</td>
<td>All</td>
<td>75</td>
</tr>
</tbody>
</table>
d. Cast-in-place prestressed concrete members must have concrete cover for reinforcement, ducts, and end fittings given in the following table:

<table>
<thead>
<tr>
<th>Concrete Exposure</th>
<th>Member</th>
<th>Reinforcement</th>
<th>Specified cover, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast against and permanently in contact with ground</td>
<td>All</td>
<td>All</td>
<td>75</td>
</tr>
<tr>
<td>Exposed to weather or in contact with ground</td>
<td>Slabs, joists, and walls</td>
<td>All</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>All other</td>
<td>All</td>
<td>40</td>
</tr>
<tr>
<td>Not exposed to weather or in contact with ground</td>
<td>Slabs, joists, and walls</td>
<td>All</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Beams, columns, and tension ties</td>
<td>Primary reinforcement, stirrups, ties, spirals, and hoops</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

e. Precast nonprestressed or prestressed concrete members manufactured under plant conditions must have concrete cover for reinforcement, ducts, and end fittings given in the following table:
<table>
<thead>
<tr>
<th>Concrete Exposure</th>
<th>Member</th>
<th>Reinforcement</th>
<th>Specified cover, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed to weather or in contact with ground</td>
<td>Walls</td>
<td>D38, D41 and D51 bars; tendons larger than 40 mm diameter</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D35 bars and smaller; 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller; tendons and strands 40 mm and smaller</td>
<td>20</td>
</tr>
<tr>
<td>All other</td>
<td></td>
<td>D38, D41 and D51 bars; tendons and strands larger than 40 mm diameter</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D19 through D35 bars; tendons and strands larger than 16 mm diameter through 40 mm</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D16 bar, 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller; tendons and strands 16 mm diameter and smaller</td>
<td>30</td>
</tr>
</tbody>
</table>
### Concrete Exposure

<table>
<thead>
<tr>
<th>Concrete Exposure</th>
<th>Member</th>
<th>Reinforcement</th>
<th>Specified cover, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not exposed to weather or in contact with ground</td>
<td>Slabs, joists, and walls</td>
<td>D38, D41 and D51 bars; tendons larger than 40 mm diameter</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tendons and strands 40 mm diameter and smaller</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D35, 16 mm diameter smooth, or 16 mm diameter deformed wire, and smaller</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Beams, columns, pedestals, and tension ties</td>
<td>Primary reinforcement Greater of bar diameter and 16 and need not exceed 40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stirrups, ties, spirals, and hoops</td>
<td>10</td>
</tr>
</tbody>
</table>

### 3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

### 3.5.2 Vapor Retarder [and Vapor Barrier]

a. Level and compact base material and install vapor retarder [vapor barrier] with the longest dimension parallel with the direction of concrete pour and face laps away from direction of pour whenever possible. Extend vapor retarder [vapor barrier] over footings, and seal to foundation wall, grade beam, or slab at an elevation consistent with the top of the slab or terminate at impediments such as dowels or water stops. Seal around all penetrations such as utilities and columns with vapor retarder [vapor barrier] material and seal tape. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 300 mm and tape. [Extend vapor retarder [vapor barrier] over the tops of pile caps and grade beams to a distance acceptable to the contracting officer and terminate as recommended by the manufacturer.]

b. Protect vapor retarder [vapor barrier] from damage during installation of reinforcing steel, utilities and concrete. Provide reinforcing bar supports with base section that minimize the potential for puncture of vapor retarder [vapor barrier]. Avoid use of stakes driven through the vapor retarder [vapor barrier].

c. Inspect installation of vapor retarder [vapor barrier] including sealing of joints and penetrations and mark all areas of damage and insufficient installation in advance of concrete placement such that
deficiencies are corrected before concrete is placed. Remove torn, punctured or damaged vapor retarder [vapor barrier] and repair damaged areas prior to concrete placement with vapor retarder [vapor barrier] material lapped and sealed a minimum of 150 mm beyond damaged area or as instructed by the manufacturer.

[d. Place a 50 mm layer of clean concrete sand on vapor retarder [vapor barrier] before placing concrete.]

3.5.3 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive must be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.5.4 Reinforcement Supports

Provide reinforcement support in accordance with JASS 5 and MLIT-SS Chapter 6. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 50 mm beyond the point of contact with the bars.

3.5.5 Splicing

Lap slice lengths and locations as indicated in the Contract Documents. For splice locations not indicated follow JASS 5 and MLIT-SS Chapter 6, at no additional cost to the Government and subject to approval. Splicing must be by lapping, by gas pressure welding, or by mechanical or welded connection, except that lap splices must not be used for bars larger than D35. Do not splice at points of maximum stress and stagger splices a minimum of [600][1200][_____] mm or as otherwise indicated so no more than half of the bars are spliced at any one section.

Overlap welded wire reinforcement the spacing of the cross wires, plus 50 mm.

Approve welded splices prior to use.

3.5.6 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.5.7 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.5.8 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

a. Provide fabrication tolerances that are in accordance with JASS 5 and
b. Provide hooks and bends that are in accordance with the Contract Documents.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.5.9 Placing Reinforcement

Place reinforcement in accordance with JASS 5 and MLIT-SS Chapter 6.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 25 mm from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 90 by 90 mm, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with JASS 5 and MLIT-SS Chapter 6. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

b. Equip supports on ground and similar surfaces with sand-plates.

c. Support welded wire reinforcement as required for reinforcing bars.

d. Secure reinforcements to supports by means of tie wire. Wire must be
black, soft iron wire, not less than 1.6 mm.

e. Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Contract Documents.

f. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Contract Documents.

3.5.10 Spacing of Reinforcing Bars

a. Spacing must be as indicated in the Contract Documents.

b. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

3.5.11 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.5.12 Welding

Welding must be in accordance with JASS 6. Welders shall be certified in accordance with JIS Z 3881 for gas pressure welding. Welded joint connections shall develop 125 percent of the specified yield strength of the reinforcing bar and 100 percent of the specified tensile strength of the reinforcing bar.

3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

In accordance with JIS A 5308, JASS 5 and MLIT-SS Chapter 6, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

3.6.2 Mixing

a. Mix concrete in accordance with JIS A 5308, JASS 5 and MLIT-SS Chapter 6.

b. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 29 degrees C.

c. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 29 degrees C except as follows: if set
retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and submitted water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required.

d. [If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. ]Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with JASS 5 and MLIT-SS Chapter 6.

3.7.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 100 mm greater than indicated.

3.7.2 Pumping

JASS 5 and MLIT-SS Chapter 6. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 50 mm at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.7.3 Cold Weather

Cold weather concrete must meet the requirements of JASS 5 and MLIT-SS Chapter 6 unless otherwise specified. Do not allow concrete temperature to decrease below 10 degrees C. Obtain approval prior to placing concrete when the ambient temperature is below 4 degrees C or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 10 degrees C minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 3 degrees C in any 1 hour and 10 degrees C per 24 hours after heat application.

3.7.4 Hot Weather

Hot weather concrete must meet the requirements of JASS 5 and MLIT-SS Chapter 6 unless otherwise specified. Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate.
from exceeding 1 kg per square meter of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.5 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 22.5 liters of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1.6 mm. Deposit fresh concrete before cement grout has attained its initial set.

3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.8.1 Mixing Equipment

Before concrete pours, designate[ Contractor-owned site meeting environmental standards][ on-site area to be paved later in project] for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Hardened, Cured Waste Concrete

[Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement. ][Use hardened, cured waste concrete as aggregate in concrete mix if approved by Contracting Officer.]
3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material.[Return excess cement to supplier.][Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.]

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair surface defects in accordance with JASS 5 and MLIT-SS Chapter 6.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

Tolerances in accordance with JASS 5 and MLIT-SS Chapter 6 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301 or JASS 5 and MLIT-SS Chapter 6.

3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301 or JASS 5 and MLIT-SS Chapter 6.

3.9.4 [Smooth-Rubbed][Grout-Cleaned Rubbed][Cork-Floated][Exposed Aggregate] Finish

[Provide a smooth-rubbed finish per ACI 301 Section 5 in the locations indicated.][Provide a grout-cleaned rubbed finish per ACI 301 Section 5 in the locations indicated.][Provide a cork-floated finish per ACI 301 Section 5 in the locations indicated.][Provide an exposed aggregate finish per ACI 301 Section 5 in the locations indicated.]

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

In accordance with JASS 5 and MLIT-SS Chapter 6, unless otherwise specified. Slope floors uniformly to drains where drains are provided.[Depress the concrete base slab where quarry tile, ceramic tile, [or][_____] are indicated.][Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile [_____].] Where straightedge measurements are specified, Contractor must provide straightedge.
3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

3.10.1.2 Floated

Use for [surfaces to receive [roofing,] [waterproofing membranes,] [sand bed terrazzo,] [_____] [and] [exterior slabs where not otherwise specified.] Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces[,] [and] for reception of floor coverings[, and] [______]. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

3.10.1.4 Nonslip Finish

Use on surfaces of exterior platforms, steps, and landings; and on exterior and interior pedestrian ramps. Finish concrete in accordance with ACI 301 Section 5 for a dry-shake finish. After the selected material has been embedded by the two floatings, complete the operation with a [broomed] [floated] [troweled] finish.

3.10.1.5 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.10.1.6 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by [belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained.] [a burlap drag. Drag a strip of clean, wet burlap from 900 to 3000 mm wide and 600 mm longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks.] Round edges and joints with an edger having a radius of 3 mm.
3.10.1.7 Chemical-Hardener Treatment

[ Apply liquid-chemical floor hardener where indicated after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats. Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.]

3.10.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI 117 for tolerance tested by ASTM E1155.

a. Specified Conventional Value:

Floor Flatness (Ff) [20] [_____] [13] [_____] minimum
Floor Levelness (FL) [15] [_____] [10] [_____] minimum

b. Specified Industrial:

Floor Flatness (Ff) [30] [_____] [15] [_____] minimum
Floor Levelness (FL) [20] [_____] [10] [_____] minimum

3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E1155.

3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

3.10.3 Concrete Walks

Provide 100 mm thick minimum unless otherwise indicated. Provide contraction joints spaced every 1500 lineal mm unless otherwise indicated. Cut contraction joints 25 mm deep, or one fourth the slab thickness whichever is deeper, with a jointing tool after the surface has been finished. Provide 13 mm thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 15 m maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 6 mm in 1500 mm.
3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 Curbs[ and Gutters]

Provide contraction joints spaced every 3 m maximum unless otherwise indicated. Cut contraction joints 20 mm deep with a jointing tool after the surface has been finished. Provide expansion joints 13 mm thick and spaced every 30 m maximum unless otherwise indicated. Perform pavement finish.

3.10.6 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 600 mm long, 300 mm wide and 100 mm thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 JOINTS

3.11.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

3.11.1.1 Maximum Allowable Construction Joint Spacing

a. In walls at not more than 18.0 meter in any horizontal direction.

b. In slabs on ground, so as to divide slab into areas not in excess of 110 square meter.

3.11.1.2 Construction Joints for Constructability Purposes

a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 40 mm deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.11.2 Isolation Joints in Slabs on Ground

a. Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade
3.11.3 Contraction Joints in Slabs on Ground

a. Provide joints to form panels as indicated.

b. Under and on exact line of each control joint, cut 50 percent of welded wire reinforcement before placing concrete.

c. Sawcut contraction joints into slab on ground in accordance with ACI 301 Section 5.

d. Joints must be 4 mm wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

e. Sawcutting will be limited to within 12 hours after set and at 1/4 slab depth.

3.11.4 Sealing Joints in Slabs on Ground

a. Contraction and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

b. Sealed groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.12 CONCRETE FLOOR TOPPING

3.12.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

3.12.1.1 Preparations Prior to Placing

a. When topping is placed on a green concrete base slab, screed surface of base slab to a level not more than 40 mm nor less than 25 mm below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping.

b. When topping is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing beams, and elsewhere as indicated.
topping mixture, 64 mm minimum, slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping is placed.

c. When topping is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface.

3.12.1.2 Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

3.12.1.3 Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated.

3.13 CURING AND PROTECTION

Curing and protection in accordance with JASS 5 and MLIT-SS Chapter 6, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer, hardener, or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs, including [______].

3.13.1 Curing Periods

JASS 5 and MLIT-SS Chapter 6, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.13.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.
3.13.3 Curing Unformed Surfaces

a. Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

b. Accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

c. Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.13.4 Temperature of Concrete During Curing

When temperature of atmosphere is 5 degrees C and below, maintain temperature of concrete at not less than 13 degrees C throughout concrete curing period or 7 degrees C when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 27 degrees C and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 3 degrees C in any 1 hour nor 27 degrees C in any 24-hour period.

3.13.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.13.6 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.14 FIELD QUALITY CONTROL

3.14.1 Sampling

JIS A 1115. Collect samples of fresh concrete to perform tests specified. JIS A 1132 for making test specimens.

3.14.2 Testing

3.14.2.1 Slump Tests

JIS A 1101. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 16 cubic meters (maximum) of concrete.
3.14.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 10 degrees C and above 27 degrees C) for each batch (minimum) or every 16 cubic meters (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.14.2.3 Compressive Strength Tests

JIS A 1108. Make [six] [eight] 150 mm by 300 mm [100 mm by 200 mm] test cylinders for each set of tests in accordance with JIS A 1132, JIS A 1115 and applicable requirements of JASS 5 and MLIT-SS Chapter 6. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, [two cylinders at 56 days] [two cylinders at 90 days] [_____] and hold two cylinder in reserve. Take samples for strength tests of each [mix design of] [and for] [_____] concrete placed each day not less than once a day, nor less than once for each 75 cubic meters of concrete for the first 380 cubic meters, then every 380 cubic meters thereafter, nor less than once for each 500 square meters of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days[56 days] [90 days] [______]. Concrete compressive tests must meet the requirements of this section, the Contract Document, and JASS 5 and MLIT-SS Chapter 6. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

[3.14.2.4 Air Content

JIS A 1118 or JIS A 1128 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

][3.14.2.5 Unit Weight of Structural Concrete

JIS A 1116. Determine unit weight of normal weight concrete. Perform test for every 15 cubic meters maximum.

][3.14.2.6 Chloride Ion Concentration

Chloride ion concentration must meet the requirements of the paragraph titled CORROSION AND CHLORIDE CONTENT. Determine water soluble ion concentration in accordance with JIS A 1154. Perform test once for each mix design.

][3.14.2.7 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

a. Failure to meet compressive strength tests as evaluated.

b. Reinforcement not conforming to requirements specified.
c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.

d. Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified.

e. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

f. Poor workmanship likely to result in deficient strength.

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

3.14.2.8 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

3.14.2.9 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with JIS A 1107, and as follows:

a. Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

b. Test cores after moisture conditioning in accordance with JIS A 1107 if concrete they represent is more than superficially wet under service.

c. Air dry cores, (16 to 27 degrees C with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

d. Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

[ e. Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.
Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.15  REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

[3.15.1  Crack Repair

Prior to final acceptance, all cracks in excess of 0.50 mm wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

]3.15.2  Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 6 mm thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 6 mm thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

3.15.3  Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016)
Structural Welding Code – Steel

JAPANESE ARCHITECTURAL STANDARD SPECIFICATIONS (JASS)


JAPANESE INDUSTRIAL STANDARDS (JIS)


1.2  DEFINITIONS

1.2.1  A Scan

Method of data presentation on an electronic screen using rectangular coordinates in which a horizontal base line indicates elapsed time when reading from left to right. A vertical deflection in the base line indicates reflect signal amplitude.

1.2.2  Acoustically Similar Material

Material the same as that to be inspected; or another material proven to have acoustical velocity within plus or minus 3 percent and an attenuation within plus or minus 0.009843 dB/mm of the inspected material for the inspection frequency and wave mode, using the same mode as that to be used for inspection.

1.2.3  Amplitude

When referring to an indication in A scan presentation, amplitude is the vertical height of the indication measured from peak-to-peak for radio
frequency indications and trace-to-peak for video indications.

1.2.4 Attenuation

Dissipation or loss of energy as ultrasonic vibrations travel through the material. Attenuation is caused almost entirely by scattering of the ultrasonic vibrations generated by the search unit.

1.2.5 Back Reflection or End Reflection

Reflection from the opposite side, end, or boundary of the material into which the ultrasonic energy was introduced.

1.2.6 Calibration

Process of comparing an instrument or device with a standard to determine accuracy or produce a scale.

1.2.7 Couplant

Any material, usually a liquid or semiliquid, used between the search unit and the inspection surface to exclude air and to convey the ultrasonic vibrations between the search unit and the material being inspected.

1.2.8 Digital Display

Display capable of presenting multi-function a-scan, b-scan, c-scan or s-scan responses. This also includes instruments settings and parameters.

1.2.9 Decibel (dB)

Units for the logarithmic expression of the ratio of power levels. Power levels can be functions of voltage, current, or impedance, for example. Decibel units having no values of their own are only significant when a reference is stated, as 10 dB above one reference level or 6 dB below another reference level.

1.2.10 Discontinuity

Anything within a material that causes a detectable interruption in an ultrasonic beam.

1.2.11 Examination

Within the context of this specification, examination is equivalent to the word "inspection."

1.2.12 Hertz

One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of periodic variations starting at one condition and returning once to the same condition is a cycle.

1.2.13 Immersion Techniques

Test methods in which the part to be tested and the search units are immersed in water or other suitable liquid couplant. A mechanical device is used to firmly hold and direct the wave angle of the search unit. The search unit does not contact the item being inspected.
1.2.14 Indication

Visual presentation on the digital display screen resulting from a sound beam reflection from a boundary surface or discontinuity.

1.2.15 Linearity

Property of an instrument revealed by a linear change in reflected signal or displacement. The vertical linearity is determined by plotting the change in ratios of signal amplitude from two adjacent reflections from an area of known size. The horizontal linearity is determined by plotting the distance the signal is displaced along the sweep against the change in material thickness or by noting the spacing of multiple back reflections.

1.2.16 Longitudinal or Compressional Waves

Simple compression-rare-fraction waves in which particle motion within a material is linear and in the direction of wave propagation. Also called straight beams, or compressional or normal waves.

1.2.17 Longitudinal Wave Inspection

Ultrasonic technique, normally using straight beam methods, in which longitudinal waves are the dominant form.

1.2.18 Mid-Screen Reflection

Reflection whose amplitude is equal to one-half the useable screen height on the digital display.

1.2.19 Megahertz (MHz)

One million hertz per second frequency.

1.2.20 Pulse Repetition Rate

Number of spaced pulses of sound per second sent into the material being inspected.

1.2.21 Reflector

Boundary, consisting of an opposite side, crack, or separation, or a distinct change in material such as slag or porosity that reflects the ultrasonic energy the same as a mirror reflects light.

1.2.22 Refracted Waves

Waves that have undergone change of velocity and direction by passing from one material to another material with different acoustical properties. Refraction occurs wherever the angle of the incident wave to the interface is other than perpendicular.

1.2.23 Resolution

Ability to clearly distinguish signals obtained from two reflective surfaces with a minimum separation distance. Near-surface resolution is the ability to clearly distinguish a signal from a reflector at a minimum distance under the contact or near surface without interference from the
initial pulse signal. Far-surface resolution is the ability to clearly distinguish signals from reflectors displaced at minimum distances from the far or back surface when the sound beam is normal to that back surface.

1.2.24 Search Unit

Device containing a piezoelectric material used for introducing vibrations into a material to be inspected or for receiving the vibrations reflected from the material. The active element of the search unit is defined as the effective transmitting area. Search units are also called transducers or probes. They may be single or dual and contain one or two piezoelectric elements, respectively, for transmission and reception. The single search unit is sometimes enclosed in a transducer wheel or search unit wheel. The search unit may be manually handled and placed in direct contact with the material to be inspected or may be held in a fixture for immersion techniques.

1.2.25 Sensitivity

Measure of the ultrasonic equipment's ability to detect discontinuities. Quantitatively, it is the level of amplification of the receiver circuit in the ultrasonic instrument necessary to produce the required indication on the scope from the reference hole in the reference block. Also see "Standard Reference Level."

1.2.26 Shear Waves

Waves in which the particles within the material vibrate perpendicularly to the direction in which the wave travels or propagates. Also called transverse waves.

1.2.27 Standard Reference Level

Mid-screen height reflection when beaming at the 1.50 mm hole in the primary reference block or the reference hole in the secondary standard.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
   Personnel Qualification; G
   Procedure description; G

SD-03 Product Data
   Equipment and accessories

SD-06 Test Reports
   Equipment Qualifications
1.4 QUALITY ASSURANCE

1.4.1 Personnel Qualification

The three levels of responsibility associated with ultrasonic inspection are defined in JIS Z 2305. Personnel performing NDT should be level II or Level I with direct supervision. For qualification to perform ultrasonic inspection, certify personnel in accordance with JIS Z 2305 within a period of 1 year before the date of contract. Submit inspector qualifications per JIS Z 2305. Other qualification or certification may be accepted at the Contracting Officer's discretion. Personnel with only an operator or inspector trainee certification will not be considered qualified to pass judgment on the acceptability of inspected items, but may work under the direct supervision of a qualified ultrasonic inspector. Qualified ultrasonic inspectors must be able to judge the acceptability of the item in accordance with paragraph ACCEPTANCE-REJECTION CRITERIA. Only serialized NIST traceable calibration standards are to be used. The procedures to be used for personnel and equipment qualification, equipment calibration, and inspection, at least 30 days prior to their intended use. Approval by the Government will in no way affect the obligation of the Contractor to employ qualified personnel, equipment, and procedures, and to perform the inspection as specified.

1.4.2 Examinations

If the Contracting Officer doubts an individual's ability as an operator, inspector, or supervisor, recertify the individual in accordance with JIS Z 2305, using the practical exam. At the option of the Government, the Contracting Officer may witness the examination and in evaluating the results.

1.4.3 Reference Standards

Use reference standards to calibrate the inspection equipment, test its operating condition, and record the sensitivity or response of the equipment during the inspection in accordance with paragraph EQUIPMENT QUALIFICATIONS. The standards comprise a standard reference block and reference specimens as noted below.

a. Provide the standard reference block or primary standard consisting of the IIW block in AWS D1.1/D1.1M, Clause 6, Part F or JIS Z 2345. Also use the standard reference block in any reinspection on the same basis as the original inspection, even though the reinspection is to be performed by other ultrasonic instruments and accessories.

b. As an option, use other recognized working standards detailed with the IIW block in AWS D1.1/D1.1M such as the Sensitivity Calibration (SC) block. However, reference such blocks to the IIW block as noted in paragraph EQUIPMENT CALIBRATION. Include details of their use in the submitted procedure description. These blocks are the secondary standards. They must be of acoustically similar material to the welds to be inspected. The secondary standards must be suited for the applicable tests specified in paragraph EQUIPMENT QUALIFICATIONS and are used as follows, except where the IIW block is specifically required:

(1) To assure adequate penetration of the base material.
(2) To provide a secondary field standard.
(3) To calibrate the equipment and establish the standard reference level.

1.4.4 Resolution Test Block

Furnish a resolution test block in accordance with the details shown in AWS D1.1/D1.1M, Clause 6, Part F or JIS Z 2345.

1.4.5 Equipment Qualifications

Calibrate and recalibrate all NDT equipment in accordance with AWS D1.1/D1.1M requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Procedures and Methods

Use the pulse echo contact method with an A scan presentation for the ultrasonic inspection of welded joints, except that immersion techniques may be used for some applications when approved by the Contracting Officer. Use the procedures, methods, standards, and description of equipment specified herein for inspection of weldments. Include the following in the submitted procedure description:

a. Couplant.

b. Search unit characteristics including angle, size, shape, nominal frequency, type designation.

c. Method and type of wave.

d. Equipment and accessories including manufacturer, model number, date of manufacture, last date of calibration, and the manufacturer's electrical, physical, and performance specifications.

e. Decibel (dB) compensation system for distance-amplitude correction.

2.1.2 Wave Types

The types of waves and the conditions under which they are used are specified below. Unless conditions prohibit, use shear waves. A longitudinal wave procedure may be used instead, if approved by the Contracting Officer.

2.1.2.1 Shear Waves

Use refracted waves between 40 degrees and 70 degrees except where different angles are indicated in approved procedures, such as for materials less than 13 mm thick, for materials with sound velocities greater than in steel, when the weldments are not readily accessible, or when existing backing rings or backing strips are not removed. For inspection of weldments containing backing rings or backing strips, adjust the instrument and select the refracted angles in a way to separate the weldment and the backing ring reflections. Establish the search unit angle and the resulting shear wave angle in the material to be inspected for each application and include this information in the procedure submitted for
approval.

2.1.2.2 Longitudinal Waves

Specifically develop the procedure to suit the application and attain the prior approval of the Contracting Officer.

2.1.3 Changes in Procedure

Should application of an approved procedure not provide for good resolution or adequate ultrasonic penetration in the items to be inspected (see paragraph EQUIPMENT QUALIFICATIONS), make changes in procedure or equipment such as frequency, pulse repetition rate, angle of search unit, couplant, or oscilloscope. Demonstrate adequacy of the new procedure to the Contracting Officer. The Government reserves the right to require a change in test equipment during these tests if any of the following test system characteristics fall below the levels listed in paragraph EQUIPMENT QUALIFICATIONS: sensitivity, amplitude and distance linearity, signal-to-noise ratio, entry and back surface resolution and penetration.

2.1.4 Ultrasonic Equipment

Provide ultrasonic equipment conforming to the requirements listed in AWS D1.1/D1.1M Clause 6, Part F or JIS Z 3060, with the following exceptions:

a. The ultrasonic test instruments must be able to generate, receive, and to present pulses in the frequency range from 1 to 10 megahertz (MHz).

b. Measure the horizontal linearity of the ultrasonic instrument in accordance with paragraph EQUIPMENT QUALIFICATIONS.

c. In addition to the resolution test specified in AWS D1.1/D1.1M, Clause 6, Part F or JIS Z 3060, conduct both near- and far-surface resolution tests in accordance with the tests specified for these characteristics in the paragraph EQUIPMENT QUALIFICATIONS.

PART 3 EXECUTION

3.1 PREPARATION OF MATERIALS FOR INSPECTION

Surfaces must be free of the following:

3.1.1 Weld Spatter

Remove spattering or any roughness that interferes with free movement of the search unit or impairs transmission of the ultrasonic vibrations.

3.1.2 Irregularities

Those which could mask or be confused with defect indications.

3.1.3 Weld Backing Strips

Remove strips that are not to remain in place and eliminate all sharp edges and valleys by grinding or other mechanical means.
3.1.4 Dirt

Remove all loose scale, rust, paint, and dirt from the coupling surface.

3.2 EQUIPMENT CALIBRATION

Calibrate equipment in accordance with AWS D1.1/D1.1M, Clause 6, Part F.

3.3 INSPECTION PROCEDURE

Inspect all welds in accordance with JASS 6 and JIS Z 3060.

3.4 ACCEPTANCE - REJECTION CRITERIA

In accordance with AWS D1.1/D1.1M, Table [6.2] [or 6.3].

3.4.1 Inspection Test Reports

Submit test reports containing the following information:

3.4.1.1 Identification and Location of Inspection

Connection identification and location of the inspected item, the person performing the inspection, and the date of inspection.

3.4.1.2 Detail of Inspections

Details of methods, types of waves used, search units, frequencies, inspection equipment identification, and calibration data with enough information to permit duplication of the inspection at a later date.

3.4.1.3 Identification of Unacceptable Areas

Locations, dimensions, types, and area of unacceptable defects and discontinuities giving reflections over 50 percent of the reject/repair line. Note on a sketch or marked-up drawing.

3.4.1.4 Record of Repair Areas

A record of repaired areas must be furnished as well as test results for the repaired areas.

3.4.2 Inspection of Repairs

All repairs undergo the same inspection procedure that originally revealed the discontinuities. Before acceptance, the welds must meet the standards required for the original weld.

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STRUCTURAL WELDING

08/18

PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)


AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel


AWS D1.4/D1.4M (2011) Structural Welding Code - Reinforcing Steel

AWS D1.8/D1.8M (2016) Structural Welding Code- Seismic Supplement

JAPANESE ARCHITECTURAL STANDARD SPECIFICATIONS (JASS)


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS Z 3021 (2016) Welding and Allied Processes - Symbolic Representation

JIS Z 3400 (2013) Quality Requirements for Fusion
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Welding Quality Assurance Plan; G

SD-03 Product Data
Welding Procedure Qualifications; G
Welder, Welding Operator, and Tacker Qualification
Previous Qualifications
Pre-Qualified Procedures; G
Welding Electrodes and Rods

SD-06 Test Reports
Nondestructive Testing
1.3 QUALITY ASSURANCE

Except for pre-qualified (in accordance with JASS 6 and JIS Z 3420) and previously qualified procedures, each Contractor performing welding must record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M[,] AWS D1.8/D1.8M[,] JASS 6 and JIS Z 3420 and to the specifications in this section. Submit for approval copies of the welding procedure specification and the procedure qualification records for each type of welding being performed. Submission of the welder, welding operator, or tacker qualification test records is also required. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M or in accordance with JASS 6 and JIS Z 3420. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M or JASS 6 and JIS Z 3420, this specification governs.

1.3.1 General Requirements

Fabricate work in MLIT Certified Fabrication Plant. Erect work by MLIT Certified Erector.

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 3 mm and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with JASS 6 and JIS Z 3420 [and AWS D1.8/D1.8M].

(2) Component Thickness Less than 3 mm: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M or JASS 6 and JIS Z 3420.

(3) Reinforcing Steel: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.4/D1.4M or JASS 6 and JIS Z 3881.

1.3.2 Previous Qualifications

Welding procedures previously qualified by test in accordance with JASS 6, may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor’s approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under
c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.3.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in JASS 6 will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints. [No pre-qualified welding procedures are allowed. Qualify the welding procedures and welders by tests prescribed in the applicable code or specification notwithstanding the fact the code or specification may allow pre-qualified procedures.]

1.3.4 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of JASS 6, JIS Z 3801 and JIS Z 3841, [AWS D1.8/D1.8M] and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used within the applicable essential variables for welder qualification.

1.3.4.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.3.4.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.3.4.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of
the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability or there has been a gap greater than 6 months since he/she last used the process. In such a case, the tacker is required to pass the prescribed tack welding test.

1.3.5 Inspector Qualification

Submit certificates indicating that certified welding inspectors meet the requirements of JASS 6. Submit qualifications for nondestructive testing personnel in accordance with the requirements of JIS Z 2305 Levels 1 or 2 in the applicable nondestructive testing method. Level I inspectors must have direct supervision of a Level II inspector.

1.3.6 Symbols and Safety

Use symbols in accordance with AWS A2.4 or JIS Z 3021, unless otherwise indicated. Follow safe welding practices and safety precautions during welding in conformance with WES 9009.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

[Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. ]Material with welds will not be accepted unless the welding is specified or indicated on the drawings, in conformance to JASS 6 or MLIT-SS Chapter 7, or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

2.1.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS)
(submitted for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding schedule; sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and nondestructive testing; welding schedule; and other items deemed necessary by the attendees.

2.2 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, welding electrodes and rods, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator. [Use [_____] welding electrodes.] [Perform welding using the [_____] process.] Provide welding equipment and materials that comply with the applicable requirements of AWS D1.1/D1.1M or JASS 6[ and AWS D1.8/D1.8M]. Submit product data on welding electrodes and rods.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of JASS 6 and JIS Z 3400[, AWS D1.8/D1.8M and AISC 360]. [When JASS 6 and JIS Z 3400, AWS D1.8/D1.8M and AISC 360 specification conflict, the requirements of AISC 360 and AWS D1.8/D1.8M govern.]

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 1 m intervals. Identification with die stamps or electric etchers is not allowed.

3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Test [50][_____] percent of CJP welds using ultrasonic testing per Table [6.2] [or 6.3] of AWS D1.1/D1.1M. Randomly test [50][_____] percent of all PJP and fillet welds or as indicated by magnetic particle or dye penetrant testing. Verify the welds conform to paragraph STANDARDS OF ACCEPTANCE. Conform
procedures and techniques for inspection with applicable requirements of JASS 6[, AWS D1.8/D1.8M], JIS Z 2343, and JIS Z 2320. Submit a Welding Quality Assurance Plan and records of tests and inspections.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of JASS 6[,] AWS D1.8/D1.8M and the contract drawings. Submit all records of nondestructive testing.

3.3.1 Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present. Submit all records of nondestructive testing in accordance with paragraph STANDARDS OF ACCEPTANCE.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M or JASS 6[, AWS D1.8/D1.8M] and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds must meet the inspection requirements for the original welds.
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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel Buildings

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel
AWS D1.8/D1.8M (2016) Structural Welding Code—Seismic Supplement

ASME INTERNATIONAL (ASME)

ASME B46.1 (2009) Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM F3125/F3125M (2015a) Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength, Metric Dimensions

ASTM F959/F959M (2017a) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Metric Series

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70 (2015) Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes

JAPANESE ARCHITECTURAL STANDARD SPECIFICATIONS (JASS)


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS B 1180 (2014) Hexagon Head Bolts and Hexagon Head Screws

JIS B 1181 (2014) Hexagon Nuts and Hexagon Thin Nuts

JIS B 1186 (2013) Sets of High Strength Hexagon Bolt, Hexagon Nut and Plain Washers for Friction Grip Joints

JIS B 1198 (2011) Headed Studs


JIS G 3106 (2017) Rolled Steels for Welded Structure (Amendment 1)

JIS B 1256 (2008) Plain Washers

JIS G 3136 (2012) Rolled Steel for Building Structures

JIS G 3192 (2014) Dimensions, Mass and Permissible Variations of Hot Rolled Steel Sections


JIS G 3444 (2016) Carbon Steel Tubes for General Structure

JIS G 3466 (2015) Carbon Steel Square and Rectangular Tubes for General Structure
Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Erection and Erection Bracing Drawings; G[, [____]]

SD-02 Shop Drawings
Fabrication Drawings Including Details of Connections; G[, [____]]

SD-03 Product Data
Shop Primer
Welding Electrodes and Rods
Direct Tension Indicator Washers
Non-Shrink Grout
Tension Control Bolts

SD-05 Design Data

[ Shoring and Temporary Bracing; G[, [____]]]

SD-06 Test Reports
Class B Coating
Weld Inspection Reports
Direct Tension Indicator Washer Inspection Reports
Bolt Testing Reports

[ Embrittlement Test Reports]

SD-07 Certificates

[ MLIT Structural Steel Fabricator Quality Certification]
[ MLIT Structural Steel Erector Quality Certification]

Welding Procedure Specifications (WPS)

[ Overhead, Top Running Crane Rail Beam]

[1.3 MLIT QUALITY CERTIFICATION]

Work must be fabricated by MLIT Structural Steel Fabricator, Category M [R] [H]. Submit MLIT Structural Steel Fabricator quality certification.

Work must be erected by MLIT Structural Steel Certified Erector. Submit MLIT Structural Steel erector quality certification.

[1.4 SEISMIC PROVISIONS]

Provide the structural steel system in accordance with AISC 341, Chapter J as amended by UFC 3-301-01.
1.5 QUALITY ASSURANCE

1.5.1 Preconstruction Submittals

1.5.1.1 Erection and Erection Bracing Drawings

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing. The erection drawings must conform to JASS 6 and MLIT-SS Chapter 7. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

1.5.2 Fabrication Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with JASS 6 and MLIT-SS Chapter 7. Fabrication drawings must not be reproductions of contract drawings. Sign and seal fabrication drawings by a registered professional engineer. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 or JIS Z 3021 standard welding symbols. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Clearly highlight any deviations from the details shown on the contract drawings highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.5.3 Certifications

1.5.3.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in JASS 6 and AWS D1.8/D1.8M.

1.5.3.2 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance requirements per CMAA 70.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

[Conform the design of structural steel system to AISC 360, AISC 303, AISC 341, and UFC 3-301-01.]

Provide the structural steel system, including shop primer [galvanizing], complete and ready for use. Provide structural steel systems including materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing in accordance with JASS 6 and MLIT-SS Chapter 7, except as modified in this contract.
2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, JIS G 3136, SN490B, 325 MPa. Angles and Channels JIS G 3106, SM400, 235 MPa. Plates, JIS G 3136, SN400B, 235 MPa [SN490B, 325 MPa], unless otherwise indicated on contract drawings. [Provide structural steel containing a minimum of [80][_____] percent recycled content.]

2.2.2 Structural Steel Tubing

JIS G 3466, STKR400, 245MPa. [Provide structural steel tubing containing a minimum of [25][90][_____] percent recycled content.]

2.2.3 Steel Pipe

JIS G 3444, STK 400 and 235 MPa. [Provide steel pipe containing a minimum of [50][_____] percent recycled content.]

2.3 BOLTS, NUTS, AND WASHERS

Submit the certified manufacturer's mill reports which clearly show the applicable JIS mechanical and chemical requirements together with the actual test results for the supplied fasteners.

2.3.1 Common Grade Bolts

2.3.1.1 Bolts

JIS B 1180 with 420 MPa minimum tensile strength, plain finish [hot dipped zinc coating in accordance with JIS B 1048]. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by JIS or JASS 6 specifications.

2.3.1.2 Nuts

Heavy hex style JIS B 1181, plain finish [hot dipped zinc coating in accordance with JIS B 1048].

[2.3.1.3 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin must slide along the bolt threads, and by reversing the direction of the locking pin, the nut can be removed without damaging the nut or bolt. Provide stainless steel locking pins.

]2.3.1.4 Washers

JIS B 1256, plain finish [hot dipped zinc coating in accordance with JIS B 1048].

2.3.2 High-Strength Bolts

High strength bolts and nuts must be shipped together in the same shipping container. Fasteners indicated to be galvanized shall be tested by the supplier to show that the galvanized nut with the supplied lubricant
provided may be rotated from the snug tight condition well in excess of the rotation required for pretensioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

2.3.2.1 Bolts

JIS B 1186, Type F10T.

[JIS B 1186, Type F8T hot dipped zinc coating] [MLIT certified 12G SHTB hot dipped zinc coating].

2.3.2.2 Nuts

JIS B 1186, F10 [hot dipped zinc coating].

2.3.2.3 Direct Tension Indicator Washers

ASTM F959/F959M.[ Provide ASTM B695, Class 55, Type 1 galvanizing.] Submit product data for direct tension indicator washers.

2.3.2.4 Washers

JIS B 1186, F35, plain carbon steel [hot dipped zinc coating].

2.3.3 Tension Control Bolts

MLIT approved JSS II 09, JIS B 1186 S10T twistoff style assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Assembly finish must be [plain]. Submit product data for tension control bolts.

2.3.4 Foundation Anchorage

2.3.4.1 Anchor Rods

JIS B 1220 ABR 400 [ABR490] [hot dipped galvanized]. [Stainless steel JIS B 1220, ABR520SUS.] [Stainless steel JIS B 1220, ABR520SUS conforming to JIS G 4321, Type SUS316A.]

2.3.4.2 Anchor Nuts

Hexagon nuts JIS B 1220 ABR 400 [ABR490] [hot dipped galvanized]. [Stainless steel JIS B 1220, ABR520SUS.] [Stainless steel JIS B 1220, ABR520SUS conforming to JIS G 4321, Type SUS316A.]

2.3.4.3 Anchor Washers

JIS B 1220 ABR 400 [ABR490] [hot dipped galvanized]. [Stainless steel JIS B 1220, ABR520SUS.] [Stainless steel G 4321 Type SUS316A conforming to JIS B 1220].

2.3.4.4 Anchor Plate Washers

JIS B 1220 ABR 400 [ABR490] [hot dipped galvanized]. [Stainless steel JIS G 4321 Type SUS304A [Type SUS316A] conforming to JIS B 1220].
2.4  STRUCTURAL STEEL ACCESSORIES

2.4.1  Welding Electrodes and Rods

AWS D1.1/D1.1M or JASS 6[ and AWS D1.8/D1.8M]. Submit product data for welding electrodes and rods.

2.4.2  Non-Shrink Grout

Packaged dry, hydraulic cement non-shrink grout, that is non-metallic, non-corrosive, non-bleed, with the following performance requirements when prepared using the highest water-to-solids ratio, maximum flow, or most fluid consistency at 23.0 plus/minus 2.0 degrees C:

a. Minimum compressive strengths: 7.0 MPa at 1 day; 17.0 MPa at 3 day; 24.0 MPa at 7 day; and 34.0 MPa at 28 day.

b. Early height change (maximum percent at time of final setting): + 4.0 percent.

c. Height change of moist cured hardened grout: 0.0 to + 0.3 percent at 1-day, 3-day, 14-day and 28-day.

2.4.3  Welded Shear Stud Connectors

JIS B 1198 [,450MPa minimum ultimate tensile strength] [and 350MPa minimum yield strength].

[2.5  GALVANIZING

JIS B 1048 for threaded parts or JIS H 8641 for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

]2.6  FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325 and JASS 6. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt [and pin] holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 13 micrometer as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in JIS G 3192, JIS G 3193, and JASS 6.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

[ Do not splice truss top and bottom chords except as approved by the Contracting Officer. Provide chord splices at panel joints at approximately the third point of the span. The center of gravity lines of truss members must intersect at panel points unless otherwise approved by the Contracting Officer. When the center of gravity lines do not intersect at a panel point, make provisions for the stresses due to eccentricity. Camber of trusses must be 3 mm in 3.0 meters unless otherwise indicated.
2.6.1 Markings

Prior to erection, identify members by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. (Affix embossed tags to hot-dipped galvanized members.)

2.6.2 Shop Primer

Shop prime structural steel, JIS K 5674 lead free, chromium free, anticorrosive paint, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, [surfaces to receive sprayed-on fireproofing], [surfaces to receive epoxy coatings], [surfaces designed as part of a composite steel concrete section], [slip critical surfaces of high strength bolted connections], or surfaces within 13 mm of the toe of the weld prior to welding (except surfaces on which metal decking and shear studs are to be welded). If flash rusting occurs, re-clean the surface prior to application of primer. Apply primer [in accordance with endorsement "SPE-P1" "SPE-P2"] "SPE-P3" of AISC 420 or approved equal NACE or SSPC certification [_____] to a minimum dry film thickness of 0.05 mm. Submit shop primer product data.

Prime slip critical surfaces with a Class B coating in accordance with AISC 325. Submit test report for Class B coating.

Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 7 degrees C or over 35 degrees C; or when the primer may be exposed to temperatures below 4 degrees C within 48 hours after application, unless approved otherwise by the Contracting Officer. Repair damaged primed surfaces with an additional coat of primer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.3 [Fireproofing] [and] [Epoxy] Coated Surfaces

Clean and prepare surfaces to receive [sprayed-on fireproofing] [epoxy] coatings in accordance with the manufacturer's recommendations, and as specified in Section 07 81 00 SPRAY-APPLIED FIREPROOFING.

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.7 DRAINAGE HOLES

Drill adequate drainage holes to eliminate water traps. Hole diameter must be 13 mm and location indicated on the detail drawings. Hole size and locations must not affect the structural integrity.
PART 3 EXECUTION

3.1 ERECTION

a. Erection of structural steel must be in accordance with the applicable provisions of AISC 325, AISC 303 and 29 CFR Part 1926, Subpart R or MLIT-SS Chapter 7 and JASS 6.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions or MLIT-SS Chapter 7 and JASS 6.

3.1.1 STORAGE

Store the material out of contact with the ground in such manner and location as to minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, design connections indicated in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

Tighten JIS B 1180 bolts to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all JIS B 1186 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, fully tension bolts, progressing from the most rigid part of a connection to the free edges.

Fastener components shall be protected from dirt and moisture in closed containers at the site of the installation. Fastener components that are not incorporated into the work shall be returned to protected storage at the end of the work shift.

3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, install the DTIW under the bolt head and tighten the nut. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the DTIW, provide flat washers under both the bolt head and nut when JIS Bolts equivalent to ASTM F3125/F3125M, Grade A490M bolts are used.
3.2.3 Tension Control Bolts

Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, fully tension bolts, progressing from the most rigid part of a connection to the free edges.

3.3 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors is not permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.4 WELDING

Welding must be in accordance with JASS 6 and AWS D1.8/D1.8M. Grind exposed welds smooth as indicated. Provide JASS 6 qualified welders, welding operators, and tackers.

Develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Submit for approval all WPS, whether prequalified or qualified by testing.

3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

[Removal is not required][Remove only from finished areas]. Remove backing strips from bottom flange of moment connections, backgouge the root pass to sound weld metal and reinforce with a 8 mm fillet weld minimum.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field prime steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using JASS 6 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing[, except that electric power for field tests will be furnished as set forth in Division 1]. Notify the Contracting Officer in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.
3.7.1 Welds

3.7.1.1 Visual Inspection

Perform in accordance with JASS 6. Furnish the services of certified welding inspectors for fabrication and erection inspection and testing and verification inspections. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of Japanese Welding Engineering Society (JWES) and JASS 6.

[ Inspect proper preparation, size, gaging location, and acceptability of all welds; identification marking; operation and current characteristics of welding sets in use.]

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with JASS 6 and JIS Z 3060[ and AWS D1.8/D1.8M]. Ultrasonic testing must be performed in accordance with Table [6.2] [or 6.3] of AWS D1.1/D1.1M. Test locations must be [as indicated] [selected by the Contracting Officer]. All personnel performing NDT must be certified in accordance with JIS Z2305 in the method of testing being performed. Submit certificates showing compliance with JIS Z2305 for all NDT technicians. If more than [20] percent of welds made by a welder contain defects identified by testing, then all groove welds made by that welder must be tested by ultrasonic testing, and all fillet welds made by that welder must be inspected by magnetic particle testing (MT) or dye penetrant testing (PT) as approved by the Contracting Officer. When groove welds made by an individual welder are required to be tested, magnetic particle or dye penetrant testing may be used only in areas inaccessible to ultrasonic testing. Retest all repaired areas. Submit weld inspection reports.

Testing frequency: Provide the following types and number of tests:

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Number of Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasonic</td>
<td>[_____] 50 percent of CJP Welds</td>
</tr>
<tr>
<td>Magnetic Particle</td>
<td>[_____] 50 percent of PJP and Fillet Welds</td>
</tr>
<tr>
<td>Dye Penetrant</td>
<td>[_____] 50 percent of PJP and Fillet Welds</td>
</tr>
<tr>
<td>[_____]</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

3.7.2 Direct Tension Indicator Washers

3.7.2.1 Direct Tension Indicator Washer Compression

Test direct tension indicator washers in place to verify that they have been compressed sufficiently to provide the 0.38 mm gap, as required by ASTM F959/F959M. Submit direct tension indicator washer inspection reports.

3.7.2.2 Direct Tension Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, must test in place the direct tension indicator...
gaps on 20 percent of the installed direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. If more than 10 percent of the direct tension indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F959/F959M, test all in place direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. Test locations must be selected by the Contracting Officer.

3.7.3 High-Strength Bolts

3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of [3] bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.7.3.2 Inspection

Inspection procedures must be in accordance with JASS 6 and MLIT-SS Chapter 7. As a minimum, high-strength bolting inspection tasks shall be in accordance with Section 01 45 35 SPECIAL INSPECTION. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

[ Inspect calibration of torque wrenches for high-strength bolts.]

3.7.3.3 Testing

The Government has the option to perform nondestructive tests on [5] percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than [10] percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

3.7.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication. Submit embrittlement test reports.

3.7.5 Inspection and Testing of Steel Stud Welding

Perform verification inspection and testing of steel stud welding
conforming to the requirements of JASS 6, Stud Welding Clause. The Contracting Officer will serve as the verification inspector. Bend test studs that do not show a full 360 degree weld flash or have been repaired by welding as required by JASS 6, Stud Welding Clause. Studs that crack under testing in the weld, base metal or shank will be rejected and replaced by the Contractor at no additional cost.

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SECTION 05 30 00

STEEL DECKS

05/15

PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

FM GLOBAL (FM)

FM APP GUIDE  (updated on-line) Approval Guide
http://www.approvalguide.com/


JAPANESE ARCHITECTURAL STANDARD SPECIFICATIONS (JASS)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 1198  (2011) Headed Studs

JIS G 3106  (2017) Rolled Steels for Welded Structure (Amendment 1)

JIS G 3352  (2014) Deck Plate

JIS H 8641  (2007) Hot Dip Galvanized Coatings


JIS K 5553  (2006) Thick Film Zinc Rich Paint


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70  (2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17 ) National Electrical Code

STEEL DECK INSTITUTE (SDI)

ANSI/SDI C  (2017) Standard for Composite Steel Floor Deck - Slabs
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor QC approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
  Fabrication Drawings; G[, [_____]]

SD-04 Samples
  Metal Roof Deck Units
  Cellular Metal Floor Deck Units
Acoustical Material

SD-05 Design Data

Deck Units; G[, [____]]

SD-07 Certificates

Welder Qualifications
Welding Procedures
Fire Safety
Wind Storm Resistance
Manufacturer's Certificate
Stud Manufacture's Certification
Stud Manufacture's Test Reports

1.3 QUALITY ASSURANCE

1.3.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.3.2 Qualifications for Welding Work

Follow Welding Procedures of JASS 6 for sheet steel and for stud welding.

Submit qualified Welder Qualifications in accordance with JASS 6 and JIS Z 3801 for sheet steel and JASS 6 for stud welding, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. [Test specimens shall be made in the presence of Contracting Officer and shall be tested by an approved testing laboratory at the Contractor's expense.] If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.3.3 Regulatory Requirements

1.3.3.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Fire Resistance, or listing as Class I construction in the FM APP GUIDE, and so labeled.

1.3.3.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding a nominal uplift
pressure of [3] [5] [_____] kPa when tested in accordance with the uplift pressure test described in the FM DS 1-28R or as described in UL 580 and in general compliance with UFC 3-301-01.

1.3.4 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, cant strips, ridge and valley plates, metal closure strips, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load must not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of JIS G 3352.

1.5.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 DECK UNITS

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

Provide products with an average recycled content of steel products so postconsumer recycled content plus one half of preconsumer recycled content not less than [25] [_____] percent.

2.1.1 Roof Deck

Conform to JIS G 3352-SDP2G for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of [[0.80] [_____] mm design thickness or thicker steel] [the steel design thickness required by the design drawings] and [shop painted] [galvanized] [painted with an epoxy coating or equivalent applied to prime-coating in accordance with manufacturer's standard] [zinc-coated in conformance with JIS G 3352-SDP2G, 227 coating class. Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.]
2.1.2 Composite Deck

[Conform to JIS G 3352-SDP2G for composite deck assembly. Fabricate deck used as the tension reinforcing in composite deck of [0.80] [_____] mm design thickness or thicker steel with integrally embossed or raised pattern ribs.] [The steel design thickness required by the design drawings. Zinc-coat in conformance with JIS G 3352-SDP2G, Z27 coating class.] [Shore composite deck until the concrete has reached [75][_____] percent of its specified strength.]

2.1.3 Cellular Metal Floor Deck Units

Provide decking as wire raceways conforming to NFPA 70. Conform to [JIS G 3352-SDP2G, SS, Grade 230 Z27]; for formed [cellular] [and] [non-cellular] decking and accessories. Provide nominal thickness of the steel sheets, before galvanizing, a minimum 1.2 millimeter for the upper element of the floor deck unit, and a minimum 1.6 millimeter for the lower element of the floor deck unit [as required by the design drawings]. [Furnish one sample of each type of Metal Floor Deck Units used to illustrate the actual cross section dimensions and configuration.]

2.1.4 Form Deck

Conform to JIS G 3352-SDP2G for deck used as formwork for concrete. Fabricate form deck of [0.80] [_____] mm design thickness or thicker steel.] [the steel design thickness required by the design drawings.] [Paint with one coat of manufacture's standard paint.] [Zinc-coat in conformance with JIS G 3352-SDP2G, Z27 coating class.]

Provide sufficient welds, forming the steel sheets into the cellular floor deck unit, to develop the full horizontal shear at the plane where the steel sheets are joined.

Cellular metal floor deck units must be fluted section cells combined [on a flat plate][with a matching fluted bottom section] having interlocking type sidelaps. Provide depth, width of unit, number of cells per unit, and width of cells as indicated.

Use panels of maximum possible lengths to minimize end laps. Fabricate deck units in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. [Factory apply a standard, phosphatized and painted, baked-on enamel finish to underside of steel decking.] [Floor] [and] [Roof] deck system design is based on shored construction.

2.1.5 Length of Deck Units

Provide deck units of sufficient length to span three or more spacings where possible.

2.1.6 Shop Priming

Shop prime accessories and [underside of] deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.
2.1.7 Touch-Up Paint

Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust. The method and extent of surface preparation and dry film thickness shall be approved by the Contracting Officer.

Provide touch-up paint for shop-painted units [of the same type used for the shop painting] [____], and touch-up paint for zinc-coated units of [an approved galvanizing repair paint with a high-zinc content, JIS K 5552] [____]. Provide touch-up paint at all welds in steel deck with a high zinc-dust content paint conforming to JIS K 5552 or JIS K 5553 and JASS 6. Remove all weld flux residue and weld splatter by wire brushing or mechanical means.

Surfaces to receive touch-up paints containing zinc dust shall be clean, dry and free of oil, grease, preexisting paint, and corrosion by-products. Spray or brush-apply the paints containing zinc dust to the prepared area in accordance with manufacturer’s instructions.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.80 mm thick to close open ends at [exposed edges of floors,] [parapets,] [end walls,] [eaves,] [and] openings through deck.

2.2.3 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations and at open ends and sides of steel roof decking. [Provide sheet steel closures above typical partitions.] [Provide sheet steel closures above fire-resistant interior walls and partitions located on both sides of wall or partition.] [Provide glass fiber blanket insulation in the space between pairs of closures at acoustical partitions.]

2.2.4 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 6 mm and over.

2.2.5 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges.
of deck. Do not cut deck until after installation of supplemental supports.

2.2.6 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 50 mm wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominal 1.2 millimeter thick before galvanizing. Provide 150 millimeter wide cover plates and form to match the contour of the floor deck units.

2.2.7 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 2 mm thick steel, [flat] [recessed] type. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap steel deck a minimum of 75 mm. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

2.2.8 Column Closures

Sheet metal, minimum 1.2 mm thick or metal rib lath.

2.2.9 Access Hole Covers

Sheet metal, minimum 1.2 mm thick.

2.2.10 Hanger

Provide clips or loops for [utility systems] [and] [suspended ceilings] of one or more of the following types:

a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 1.2 mm thick or more, and a structural concrete fill is used over deck.

b. Slots or holes punched in decking for installation of pigtails.

c. Tabs driven from top side of decking and arranged so as not to pierce electrical cells.

d. Decking manufacturer's standard as approved by the Contracting Officer.

2.2.11 Shear Connectors

Provide shear stud connectors JIS B 1198 [450MPa minimum ultimate tensile strength] [and 350MPa minimum yield strength]. Submit stud manufacture's certification that the studs delivered conform to the material requirements. Submit stud manufacture's test reports for the last completed in-plant quality control mechanical tests.

2.2.12 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 1.0 millimeter thick before galvanizing. Bend strips to form a 45-degree cant not less than 125 millimeter wide, with top and
bottom flanges a minimum 75 millimeter wide. Length of strips 3000 millimeter.

2.2.13 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 1.0 millimeter thick before galvanizing. Provide plates of minimum 120 millimeter wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 3000 millimeter.

2.2.14 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 1.0 millimeter thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.2.15 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to JIS G 3106, SM400, 235 MPa, and hot-dip galvanized in accordance with JIS H 8641.

2.2.16 Sound Absorbing Material

Provide [glass fiber in roll or premolded form for acoustical noncellular steel roof deck] [and] [glass fiber rigid strip for acoustical cellular steel deck] in accordance with the manufacturer's standards. Provide a sample of acoustical material to be used.

2.2.17 Mechanical Fasteners

Provide mechanical fasteners, such as powder actuated fasteners, pneumatically driven fasteners or self-drilling screws, for anchoring the deck to structural supports and adjoining units[ as indicated][ that are designed to meet the loads indicated].

2.2.18 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 1.2 mm welding washers, 1.6 mm other metal accessories, 1.0 mm unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with 29 CFR 1926, Subpart R - Steel Erection, ANSI/SDI QA/QC, [ANSI/SDI C][ANSI/SDI NC][ANSI/SDI RD][SDI DDM04] and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including
material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. [Lap 50 mm] [Butted] deck ends. Do not use unanchored deck units as a work or storage platform. [Do not fill unanchored deck with concrete.] Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage. [Prepare shoring in position before concrete placement begins in composite or form deck.][ Size cellular decking provided as electrical raceways to accommodate indicated wiring systems. Chip off burrs and eliminate sharp edges which may damage wiring. Mesh decking panels accurately and place in accordance with UL 209.][ Neatly fit acoustical material into the rib voids.]

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal 16 mm diameter arc spot welds,[ fastened with screws, or pneumatically driven fasteners] as indicated on the design drawings and in accordance with manufacturer's recommended procedure[ and ANSI/SDI C, ANSI/SDI NC or ANSI/SDI RD]. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding [or fastening].[ Anchoring the deck to structural supports with powder-actuated fasteners or pneumatically driven fasteners is prohibited.] Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with JASS 6 using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in JASS 6 and JIS Z 3801 make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. [Indicate] [Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer]for location, size, and spacing of fastening. [Do][Do not] use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDM04. [Attach shear connectors as shown and welded as per JASS 6 [through the steel deck to the steel member] [directly to the steel member]]. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of [coated finish with zinc-dust paint conforming to JASS 6] [shop [primed] [painted] finish with the manufacturer's standard touch-up paint].

3.2.1.2 Sidelap Fastening

Lock sidelaps between adjacent floor deck units together by welding or screws as indicated.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings
through the deck in conformance with SDI DDP. Reinforce [holes and openings 150 to 300 mm across by 1.2 mm thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Reinforce holes and openings larger than 300 mm by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. ] [Deck manufacturer shall approve holes or openings larger than 150 mm in diameter prior to drilling or cutting. ] [Openings must not interfere with seismic members such as chords and drag struts.]

3.2.3 Deck Damage

SDI MOC3, for repair of deck damage.

3.2.4 Touch-Up Paint

3.2.4.1 Roof Deck

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

3.2.4.2 Floor Deck

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

3.2.5 Accessory Installation

3.2.5.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

3.2.5.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.5.3 Closures Above Partitions

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 100 mm nominal or less in thickness and two-piece closure strips for wider partitions. [Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation.] [Provide flexible rubber closures above acoustic-rated partitions at both sides of partition with space between filled with blanket insulation.]
3.2.5.4 Cover Plates

[Provide metal cover plates, or joint tape, at joints between cellular decking sheets to be used as electrical raceways.] [Where concrete leakage would be a problem, provide metal cover plates, or joint tape, at joints between decking sheets, cellular or noncellular, to be covered with concrete fill.]

3.2.5.5 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

3.2.5.6 Access Hole Covers

Provide access whole covers to seal holes cut in decking to facilitate welding of the deck to structural supports.

3.2.5.7 Hangers

Provide as indicated to support [utility system] [and] [suspended ceilings]. Space devices [as indicated] [so as to provide one device per 0.60 square meters].

3.2.6 Sound Absorbing Material

Install sound absorbing [glass fiber roll or premolded form, neatly in voids between perforated webs of acoustical noncellular steel deck] [and] [glass fiber rigid strip, in cells of acoustical cellular steel deck]. Keep sound absorbing material dry before, during and after installation.

3.2.7 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the Contracting Officer. Place concrete on metal deck in accordance with Construction Practice of ANSI/SDI C or ANSI/SDI NC.

3.2.8 Preparation of Fire-Proofed Surfaces

Provide deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, galvanized and free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Complete any required cleaning prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

3.3 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 300 millimeter with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.
3.4 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 300 millimeter. Lap end joints a minimum 75 millimeter and secure with galvanized sheet metal screws spaced a maximum 100 millimeter on center.

3.5 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 75 millimeter. For valley plates, provide endlaps to be in the direction of water flow.

3.6 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.7 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.9 FIELD QUALITY CONTROL

3.9.1 Headed Stud Inspection

In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in JASS 6 for stud welding and as follows:

a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

b. Conduct tests according to requirements in JASS 6 on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.9.2 Deck Weld Inspection

Visual inspect welds in accordance with JASS 6.

3.9.3 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges should not exceed manufacturing and construction tolerances of supporting members. When gap is more than the allowable, provide corrective measures or replacement. Reinspect decking
after performing corrective measures or replacement.

} -- End of Section --
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DIVISION 05 - METALS

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MISCELLANEOUS METAL FABRICATIONS

05/17

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-- End of Section Table of Contents --
1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws

JAPANESE ARCHITECTURAL STANDARD SPECIFICATION (JASS)

JASS 5 (2015) Reinforced Concrete Work


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 1111 (2017) Cross Recessed Machine Screws

JIS B 1112 (1995) Cross Recessed Head Wood Screws

JIS B 1180 (2014) Hexagon Head Bolts and Hexagon Head Screws

JIS B 1186 (2013) Sets of High Strength Hexagon Bolt, Hexagon Nut and Plain Washers for Friction Grip Joints

JIS B 1198 (2011) Headed Studs


JIS B 1251 (2018) Spring Lock Washers

JIS G 3101 (2017) Rolled Steels for General Structure (Amendment 1)

JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip

JIS G 3312 (2019) Prepainted Hot-Dip Zinc-Coated Steel Sheet and Strip

JIS G 3317 (2019) Hot-Dip Zinc-5 Percent Aluminum
Allot-Coated Steel Sheet and Strip

JIS G 3323 (2019) Hot-dip Zinc-Aluminium-Magnesium Alloy-Coated Steel Sheet and Strip

JIS G 3444 (2016) Carbon Steel Tubes for General Structure

JIS G 3466 (2015) Carbon Steel Square and Rectangular Tubes for General Structure

JIS G 3475 (2014) Carbon Steel Tubes for Building Structure


JIS H 4001 (2006) Painted and Baked Aluminum and Aluminum Alloy Sheets and Strips


JIS H 5202 (2010) Aluminum Alloy Castings

JIS H 8601 (1999) Anodic Oxide Coatings on Aluminum and Aluminum Alloys


JIS H 8641 (2007) Hot Dip Galvanized Coatings

JIS K 5553 (2006) Thick Film Zinc Rich Paint

JIS Z 0310 (2016)Abrasive Blast Cleaning Methods for Surface Preparation


JIS Z 3821 (2018) Standard Qualification Test and Acceptance Requirements for Welding Technique of Stainless Steel


ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts and Screws
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

- Structural Steel Door Frames, Fabrication Drawings; G[, [______]]
- Cover Plates and Frames, Installation Drawings; G[, [______]]
- Expansion Joint Covers, Installation Drawings; G[, [______]]
- Floor Gratings, Installation Drawings;
- Roof Walkways, Installation Drawings;
- Bollards/Pipe Guards; G[, [______]]
- Wheel Guards, Installation Drawings; G[, [______]]
- Window[ and Door] Guards, Installation Drawings;
- Embedded Angles and Plates, Installation Drawings; G[, [______]]
- Roof Hatches, Installation Drawings; G[, [______]]

SD-03 Product Data

- Corner Guards
- Cover Plates and Frames;
- Expansion Joint Covers
- Floor Gratings;
- Roof Walkways;
- Structural Steel Door Frames;
Wheel Guards
Window[ and Door] Guards;
Roof Hatches;
SD-04 Samples
Expansion Joint Covers
SD-07 Certificates

[ Certified Mill Test Reports for Chemistry and Mechanical Properties; G[, [_____]}

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with JIS Z 3801, JIS Z 3821, or JIS Z 3841. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 MISCELLANEOUS REQUIREMENTS

1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in MLIT-SS Chapter 7 and/or JASS 6.

1.5.2 Installation Drawings

Submit templates, erection, and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation in relation to the building construction.

PART 2 PRODUCTS

2.1 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied.[ Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.]

2.1.1 Structural Carbon Steel

Provide in accordance with JIS G 3101, SS 400, 235 MPa.

2.1.2 Structural Tubing

Provide in accordance with JIS G 3466, SKTR 400, 245 MPa.
2.1.3 Steel Pipe

Provide in accordance with JIS G 3444 STK 400 and 235 MPa or JIS G 3475, STKN400B and 235 MPa.

2.1.4 Fittings for Steel Pipe

Provide standard malleable iron fittings in accordance with JIS G 5702.

2.1.5 Gratings

a. Provide gray cast iron in accordance with JIS G 5501, FC300.

b. Provide metal plank grating, non-slip requirement, [aluminum in accordance with KS651-T6 or KD610-T6[DM1]] [steel in accordance with JIS G 3302 Z27].

2.1.6 Floor Plates, Patterned

Provide steel plate not less than 1.9 mm.

2.1.7 Anchor Bolts

Provide in accordance with JIS B 1220. Where exposed, provide anchor bolts of the same material, color, and finish as the metal to which they are applied.

2.1.7.1 [Expansion Anchors] [Sleeve Anchors] [Adhesive Anchors]

Provide [_____]mm diameter [expansion anchors] [sleeve anchors] [adhesive anchors]. Minimum [concrete] [masonry] embedment of [_____]mm. Design values listed are as tested in accordance with JASS 5.

a. Provide minimum [ultimate] [allowable] pullout value of [_____]kN.
   Calculate pullout capacity according to JASS 5.

b. Provide minimum [ultimate] [allowable] shear value of [_____]kN.
   Calculate shear capacity according to JASS 5.

2.1.7.2 Lag Screws and Bolts

Provide in accordance with JIS lag screws, type and grade best suited for the purpose.

2.1.7.3 Toggle Bolts

Provide in accordance with ASME B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

Provide in accordance with JIS B 1180, JIS B 1186, or JIS B 1220.

2.1.7.5 Screws

Provide in accordance with JIS B 1111 and JIS B 1112.

2.1.7.6 Washers

Provide plain washers in accordance with JIS B 1250. Provide beveled
washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers in accordance with JIS B 1251.

2.1.7.7 Welded Headed Shear Studs

Provide in accordance with JIS B 1198.

2.1.8 Aluminum Alloy Products

Provide in accordance with JIS H 4040 for extrusions and JIS H 5202 or JIS H 5202 for castings. Provide aluminum extrusions at least 3 mm thick and aluminum plate or sheet at least 1.3 mm thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with JIS G 3302, JIS G 3312, JIS G 3317, JIS G 3323 and/or JIS H 8641 Z27.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with JASS 6 12.4 and JIS K 5553 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with JIS Z 0310. Surfaces that will be exposed in spaces above ceiling or in attic spaces, furred spaces, and chases may be cleaned by means of power tools. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.2.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's printed instructions. [On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 0.03 mm. Tint additional prime coat with a small amount of tinting pigment.]
2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, JIS H 8601, JIS H 8602 or JIS H 4001. Unless otherwise specified, provide all other aluminum items with a standard mill finish[ hand sanded or machine finish to a 240 grit] anodized finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish, min. 0.7 mil for items used in exterior locations. Provide in accordance with JIS H 8601, JIS H 8602 or JIS H 4001. Provide a polished satin finish on items to be anodized.

2.3 CORNER GUARDS

For jambs and sills of openings and edges of platforms provide steel shapes and plates anchored in masonry or concrete with welded steel straps or end-weld stud anchors. Form corner guards for use with glazed or ceramic tile finish on walls with 1.6 mm thick corrosion-resisting steel with polished[ or] satin finish, extend 1.5 m above the top of cove base or to the top of the wainscot, whichever is less, and securely anchor to the supporting wall. Provide [galvanized][_____] corner guards on exterior.[ Provide interior corner guards as indicated in Section 10 26 00 WALL AND DOOR PROTECTION.]

2.4 COVER PLATES AND FRAMES

Fabricate cover plates of [6][_____] mm thick rolled steel weighing not more than 45 kg per plate with a selected raised pattern nonslip top surface[slip-resistant, carbon steel in accordance with JIS G 3101. Provide aluminum oxide or silicon carbide on wearing surfaces]. Provide [galvanized][shop painted] plate. Reinforce to sustain a live load of [_____] MPa. Provide structural steel shapes and plates for frames, [with bent steel bars or headed anchors welded to frame for anchoring to concrete][securely fastened to the structure as indicated]. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 4500 mm.[ Provide holes for lifting tools.][ Provide flush drop handles for removal where indicated; form from 6 mm round stock.][ Provide holes and openings with 13 mm clearance for pipes and equipment.] Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every 152 mm. Provide 3 mm clearance at edges and between cover plates.

2.5 EXPANSION JOINT COVERS

Provide expansion joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and standard mill finish for floor covers and exterior covers. Furnish plates, backup
angles, expansion filler strips and anchors as indicated. [Provide a \text{[____]}-hour fire-rating for expansion joints.]

2.6 FLOOR GRATINGS AND ROOF WALKWAYS

Design [steel] [aluminum] grating in accordance with manufacturer's charts for plank grating. [Galvanize steel floor gratings.]

a. Design floor gratings to support a stress live load of \text{[____]} \text{MPa} for the spans indicated, with maximum deflection of $L/240$.

b. In accordance with the manufacturer's standard for trim [unless otherwise indicated]. Design tops of bearing bars, cross or intermediate bars to be in the same plane and to match grating finish.

b. Band ends of gratings with bars of the same or greater thickness than the metal used for grating. Weld banding bars to bearing bars or channels at least every fourth bar or channel and in every corner. Tack weld intervening bars or channels. Band diagonal or round cuts by welding bars of the same or greater thickness as the grating and in accordance with the manufacturer's standard for trim [unless otherwise indicated].

c. [Attach gratings to structural members with welded-on anchors.] [Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.] [Attach grating in accordance with manufacturer's roof attachment system.]

d. Provide slip resistant surface finishes.

e. Rooftop walkway: Minimum 600 mm wide, 1.8 mm, JIS G 3302, Z27 steel with slip resistant surface. Furnish all brackets, connectors and other accessories. Support at minimum 1500 mm intervals on hard rubber pads in accordance with manufacturer's instructions.

2.7 BOLLARDS/PIPE GUARDS

Provide \text{[____]} \text{mm} [galvanized] [prime coated] [standard] [extra strong] weight steel pipe in accordance with JIS G 3444, STK 400 and 235 MPa or JIS G 3475, STKN400B and 235 MPa. Anchor posts in concrete [as indicated] and fill solidly with concrete with minimum compressive strength of 17 MPa.

2.8 DOWNSPOUT TERMINATIONS

Provide [102 x 102 mm], [102 x 152 mm] [and] [or] [152 x 152 mm] [____] aluminum downspout tile adapter with [mill] [manufacturer's standard powder coated] finish. Units shall have all seams welded.

Provide [nickel bronze] [polished bronze] [chrome plated] cast downspout nozzle and flange.

Provide [100 x 76 mm], [125 x 100 mm] [and] [or] [100 mm diameter] [____] [cast iron] [galvanized cast iron] downspout boot with cleanout access and manufacturer's standard cast iron strap.

2.9 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as lintels, sill angles, [support framing for ceiling-mounted toilet}
partitions,] miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions [as indicated and] as required to support wall loads over openings. Provide with connections and [fasteners] [welds]. Construct to have at least [[_____] mm] [200 mm] bearing on masonry at each end.

Provide angles and plates in accordance with JIS G 3101 SS400, 235 MPa, for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with JIS H 8641.

2.10 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, minimum 5 mm diameter, with a minimum of twelve links per 300 mm, and snap hooks on each end. Provide boat type snap hooks. Provide galvanized 10 mm bolt with 20 mm eye diameter for attachment of chain, anchored as indicated. Supply two chains, 100 mm longer than the anchorage spacing, for each guarded area.

2.11 SECURITY GRILLES

Fabricate of channel frames with not less than two masonry anchors at each jamb and 12 mm hardened steel bars spaced not over 100 mm both ways and welded to frame. Provide 18 by 16 mesh screen and two layers of 6 mm hardware cloth clamped to frame.

2.12 STEEL PLATE WAINSCOTS FOR CONCRETE OR MASONRY COLUMNS

Shop bend to radius for round columns and at right angles for square and rectangular columns with slight 6 mm radius on corners, with no horizontal joints and not more than 2 vertical joints single strapped and butt welded with a thickness of [______].

2.13 STRUCTURAL STEEL DOOR FRAMES

[ a. Provide frames as indicated. Unless otherwise indicated, construct frames of structural shapes, or shape and plate composite, to form a full depth channel shape with at least 40 mm outstanding legs. For single swing doors, provide continuous 16 by 40 mm bar stock stops at head and jambs. For freight elevator hoistway entrance, include a non-skid metal sill. Provide extruded metal frames as required by the elevator manufacturer.

] b. Provide support where track, guides, hoods, hangers, operators, and other accessories are required.

c. Provide jamb anchors near top, bottom, and at not more than 600 mm intervals. Provide the bottom of each jamb member with a clip angle welded in place with two 12 mm diameter floor bolts for adjustment.

[ d. Provide spreaders between bottoms of floor jamb members. When floor construction permits, spreaders may be left in place and concealed in the floor.

] Provide frames of rolled shapes as indicated. Miter and weld heads to jambs, or provide riveted clip angle connections concealed in the finished work. Provide frames for swinging doors with 16 by 40 mm solid bar stops secured to the frame by welding or by 6 mm diameter countersunk machine screws spaced not more than 300 mm on centers. Stiffen head openings greater than 900 mm as necessary to limit deflection to not more than 2 mm.

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Secure frames to masonry with zinc-coated metal anchors spaced not more than 750 mm on centers. Where necessary to engage the threads of machine screws for fastening hardware, back frames on inside faces with steel plates of suitable thickness. Tap frames and reinforcing plates as necessary for the installation of hardware and other work. Countersink rivets and screw heads where they will be exposed in the finished work. Grind welds smooth.

2.14 WHEEL GUARDS

Provide wheel guards of hollow, heavy-duty type cast iron with shaped, [rounded ][half round ][three quarters round ]top, at least 450 mm high, and designed to provide a minimum of 150 mm of protection.

2.15 ROOF HATCHES (SCUTTLES)

Provide [aluminum][zinc-coated steel] sheets not less than 1.9 mm with 75 mm beaded flange, welded and ground at corners. Provide a minimum clear opening of 760 by 900 mm. Insulate cover and curb with 25 mm thick rigid fiberboard insulation, covered and protected by [aluminum sheet][zinc-coated steel liner] of not less than 0.45 mm. Provide with 300 mm high curb, formed with 75 mm mounting flanges with holes for securing to the roof deck.

2.16 WINDOW[ AND DOOR] GUARDS, DIAMOND-MESH TYPE

Provide diamond-mesh window[ and door] guards constructed of woven steel wire [or expanded metal ]framed with hot-rolled or cold-formed structural steel shapes. Provide woven wire panels of 3.3 mm, 40 mm mesh secured through weaving bar to 25 by 12 by 3 mm thick channel frame.[ Provide expanded metal panels in accordance with ASTM F1267.] Miter and weld corners of frames.[ Mount window[ and door] guards on interior of window[ and door] frame with not less than two tamperproof hinged butts mounted on wood jambs with 6 mm lag bolts, to masonry jamb with toggle bolts, or welded to metal jambs.][ Mount window[ and door] guards on exterior of window frame with not less than two tamperproof hinged butts mounted on 25 by 12 by 3 mm jamb channel attached as indicated to 50 by 6 mm plate anchored to wood jamb with 6 mm lag bolts; to masonry jamb with toggle bolts, or to concrete jambs and solid masonry jambs with expansion shields and bolts. ] Provide one additional butt for each 900 mm internal length of guard over 1500 mm. Provide one tamperproof hasp and padlock, with access from the interior, for each butt used and installed on the jamb opposite to that hinged.[ Provide galvanized guards and accessories.]

2.17 WINDOW[ AND DOOR] GUARDS

Provide woven wire window[ and door] guards of size as necessary to completely fill opening. Construct guards with 10 mm round rod frame and 40 mm diamond-mesh of No. 10 U.S. Gage 3.4 mm wire. Provide all materials with zinc coating. Provide a minimum of three hinge side clips on one side and two lock ring hasps on the opposite side.

2.18 CLEANOUT DOORS

Provide [galvanized ][cast iron ]cleanout doors with frames, sized to match flues unless otherwise indicated. Provide continuous flange and anchors for securing frames to masonry. Provide smokeproof, hinged doors with[ lockable] fastening devices to hold doors closed[ and secured].
2.19 COAL HOPPER DOORS

Provide coal hopper doors of [galvanized][_____] steel plates and shapes. Provide complete assemblies including frames, stops, wall boxes, hinges, and hasp or lock-type latches. Weld joints and attachments.

2.20 GUY CABLES

Provide guy cables as pre-stretched, galvanized wire rope of sizes indicated. Provide wire rope high strength grade. Guys must have a factory attached clevis top-end fitting, a factory attached open-bridge strand socket bottom-end fitting, and must be complete with oval eye, threaded anchor rods. Provide hot-dip galvanized fittings and accessories.

2.21 WINDOW SUB-SILL

Provide window sub-sill of extruded aluminum alloy, standard mill finish, of size(s) and design(s) indicated. Provide a minimum of two anchors per window section for securing to mortar joints of masonry sill course. Provide sills with protective coating for shipment, of two coats of a clear, colorless, methacrylate lacquer applied to all surfaces of the sills.

2.22 WINDOW WELLS

Provide window wells in a minimum 1.5 mm, corrugated sheet steel, hot-dip galvanized after fabrication, with top edge of window well walls with a 19 mm bead or rolled top. Provide windows wells with radiused corners and of sizes that overlap each window by a minimum of 75 mm on each side. Provide removable covers, hot-dipped galvanized after fabrication, consisting of steel bar grate, with bars spaced at not more than 50 mm centers and welded to 25 by 6 mm frame. Frames must fit into, and rest on top edge of, window wells.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated in accordance with manufacturer's instructions. Verify all field dimensions prior to fabrication. Include materials and parts necessary to complete each assembly, whether indicated or not. Miss-alignment and miss-sizing of holes for fasteners is cause for rejection. Conceal fastenings where practicable. Joints exposed to weather must be watertight.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is true and accurate in shape, size, and profile. Make angles and lines continuous and straight. Make curves consistent, smooth and unfaceted. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections. Unless otherwise indicated and approved, provide a smooth finish on exposed surfaces. Provide countersuck rivets where exposed. Provide coped and mitered corner joints aligned flush and without gaps.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage as necessary, whether indicated or not, for fastening miscellaneous metal items securely in place. Include slotted inserts,
expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, JIS B 1198 welded headed shear studs, machine and carriage bolts for steel, through bolts, lag bolts, and screws for wood. Do not use wood plugs. Provide non-ferrous attachments for non-ferrous metal. Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals), that generally match in color and finish the surfaces to which they are applied. Conceal fastenings where practicable. Provide all fasteners flush with the surfaces they fasten, unless indicated otherwise.[ Test a minimum of 2 bolt, nut, and washer assemblies from each certified mill batch in a tension measuring device at the job site prior to the beginning of bolting start-up.]

3.4 BUILT-IN WORK

Where necessary and not otherwise indicated, form built-in metal work for anchorage with concrete or masonry. Provide built-in metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding in accordance with JASS 6. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Provide welded headed shear studs in accordance with JASS 6, Clause 7, except as otherwise specified. Provide in accordance with the safety requirements of EM 385-1-1.

3.6 DISSIMILAR METALS

Where dissimilar metals are in contact, protect surfaces with a coating to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with asphalt-base emulsion. Clean surfaces with metal shavings from installation at the end of each work day.

3.7 PREPARATION

3.7.1 Material Coatings and Surfaces

Remove rust preventive coating just prior to field erection, using a remover approved by the metal manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.7.2 Environmental Conditions

Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C, unless approved by the Contracting Officer. Metal surfaces to be painted must be dry for a minimum of 48 hours prior to the application of primer or paint.

3.8 EXPANSION JOINT COVERS

Provide in accordance with manufacturer's written instructions[ and with seismic requirements indicated]. Verify installation allows specified movement prior to completion of work.
3.9 COVER PLATES AND FRAMES

Provide tops of cover plates and frames flush with finished surface. Test for trip hazards and adjust for any encountered lippage.

3.10 WHEEL GUARDS

Anchor guards to concrete or masonry in accordance with manufacturer's instructions. Fill hollow cores solid with concrete with minimum compressive strength of 17 MPa.

3.11 ROOF HATCH (SCUTTLES)

Construction and accessories as follows:

a. Provide insulated cover and curb with mounting flanges for securing to roof deck. Provide curbs with integral metal cap flashing of the same gage and metal as the curb, fully welded and ground at corners for weather tightness.

b. Provide hatches completely assembled, with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latches with turn handles on inside and outside, and neoprene draft seals. Provide fasteners for padlocking from the inside. Provide covers with automatic hold-open arms complete with grip handle to permit one hand release. Cover action must be smooth through its entire range of motion with an operating pressure of approximately 130 N.

3.12 DOOR GUARD FRAME

Mount door guard frames over glazed openings using 6 mm lag bolts on the interiors of wood doors or tamperproof through bolts on the interiors of metal doors.

3.13 INSTALLATION OF BOLLARDS/PIPE GUARDS

Set bollards/pipe guards vertically in concrete piers. Fill hollow cores with concrete having a minimum compressive strength of 21 MPa.

3.14 INSTALLATION OF DOWNSPOUT TERMINATIONS

Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

3.15 MOUNTING OF SAFETY CHAINS

Provide safety chains where indicated. Mount the top chain 1050 mm[_____] above the [floor][ground] and mount the lower chain 600 mm [_____] above the [floor][ground].

3.16 STRUCTURAL STEEL DOOR FRAMES

Secure door frames to the floor slab by means of angle clips and expansion bolts. Provide any necessary reinforcements and drill and tap frames as required for hardware. Clean metal shavings from finished surfaces at the end of each work day.

For freight elevator hoistway entrances, include a non-skid metal sill installed in accordance with the elevator manufacturer's written
installation instructions.

3.17 INSTALLATION OF WHEEL GUARDS

Fill wheel guards with concrete and anchor to slab in accordance with manufacturer's recommendations.

3.18 BAR-GRILLE WINDOW GUARDS

Securely anchor bar-grille window guards to masonry with 13 mm diameter prison-type screws or bolts and expansion shields, or other type of fastenings if the ends of such fastenings are welded to the adjoining metal grilles or otherwise made tamperproof in manner as approved by the Contracting Officer. Spanner-head screws or bolts are not considered prison-type fasteners.

3.19 DIAMOND MESH WINDOW [AND DOOR] GUARDS

Provide diamond mesh window guards on [interior window frames with not less than two tamperproof hinged butts mounted on wood jambs.][exterior of window frames with not less than two tamperproof hinged butts mounted on 25 by 300 by 3 mm jamb channel attached to 50 by 6 mm plate anchored][ to wood jambs with 6 mm lag bolt,] to masonry jamb with toggle bolts[, or to concrete jambs and solid masonry jambs with expansion shields and bolts]. Provide one additional butt for each 900 mm internal length of guard over 1500 mm. Install hasp and padlock jamb opposite the hinged side.

3.20 INSTALLATION OF WINDOW WELLS

Provide window wells with walls securely anchored to foundation surface. Excavate the area within the well to the bottom of the well and cover with a 100 mm thick layer of coarse gravel or crushed rock.

3.21 INSTALLATION MISCELLANEOUS PLATES AND SHAPES

Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions[ as indicated and] as required to support wall loads over openings. Provide with connections and [fasteners][welds]. Construct to have at least 200 mm bearing on masonry at each end.

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METAL LADDERS

02/16

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS G 3101   (2017) Rolled Steels for General Structure (Amendment 1)
JIS G 3302   (2019) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 3444   (2016) Carbon Steel Tubes for General Structure
JIS G 3466   (2015) Carbon Steel Square and Rectangular Tubes for General Structure
JIS H 4000   (2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)
JIS H 4100   (2015) Aluminum and Aluminum Alloy Extrusions
JIS H 5202   (2010) Aluminum Alloy Castings
JIS K 2208   (2009) Asphalt Emulsion
JIS K 5553   (2006) Thick Film Zinc Rich Paint
JIS H 8641   (2007) Hot Dip Galvanized Coatings
JIS Z 0310   (2016) Abrasive Blast Cleaning Methods for Surface Preparation
JIS Z 3410   (2013) Welding Coordination - Tasks and
Responsibilities


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Ladders, Installation Drawings
   Ship's Ladder (With or Without Guards), Installation Drawings

SD-03 Product Data
   Ladders
   Ship's Ladder (With or Without Guards)
   Ladder Safety Devices (Climbing Ladder Fall Arrest Systems)

SD-07 Certificates
   Fabricator Certification for Ladder Assembly
   Fabricator Certification for Ships Ladder Assembly

1.3 CERTIFICATES

Provide fabricator certification for ladder assembly stating that the ladder and associated components have been fabricated according to the requirements of JIS B 9713-4.

Provide fabricator certification for ships ladder assembly stating that the ships ladder and associated components have been fabricated according to the requirements of JIS B 9713-4.

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with JIS Z 3801, or JIS Z 3841. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store
items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2   PRODUCTS

2.1   MATERIALS

2.1.1   Structural Carbon Steel
        JIS G 3101.

2.1.2   Structural Tubing
        JIS G 3466.

2.1.3   Steel Pipe
        JIS G 3444, STK400.

2.1.4   Fittings for Steel Pipe
        Standard malleable iron fittings JIS G 5705.

2.1.5   Aluminum Alloy Products
        Conform to JIS H 4000 for sheet plate, JIS H 4100 for extrusions and JIS H 5202 for castings, as applicable. Provide aluminum extrusions at least 3 mm thick and aluminum plate or sheet at least 1.3 mm thick.

2.2   FABRICATION FINISHES

2.2.1   Galvanizing
        Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: JIS B 1048, JIS H 8641, JIS G 3302, Z27, as applicable.

2.2.2   Galvanize
        Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3   Repair of Zinc-Coated Surfaces
        Repair damaged surfaces with galvanizing repair method and paint conforming to JIS K 5553 by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4   Shop Cleaning and Painting

2.2.4.1   Surface Preparation
        Blast clean surfaces in accordance with JIS Z 0310. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned with power tools. Wash cleaned surfaces...
which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. [On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 0.03 mm. Tint additional prime coat with a small amount of tinting pigment.]

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium. Unless otherwise specified, provide all other aluminum items with [standard mill finish.] [hand sanded or machine finish to a 240 grit.] Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations.

2.3 LADDERS

Fabricate vertical ladders conforming to JIS B 9713-4. Ladders shall be capable of supporting their maximum intended load. Use 65 by 10 mm steel flats for stringers and 20 mm diameter steel rods for rungs. Ladder rungs, step and cleats must be spaced not less than 25 cm and not more than 400 mm wide (measured before installation of ladder safety system), spaced no more than 36 cm apart, plug welded or shouldered and headed into stringers. Install ladders so that the maximum perpendicular distance from the centerline of the steps or rungs, or grab bars, or both, to the nearest permanent object in the back of the ladder or to the finished wall surface will not be less than 175 mm, except for the elevator pit ladders, which have a minimum perpendicular distance of 11 cm. Provide heavy clip angles riveted or bolted to the stringer and drilled[ for not less than two 12 mm diameter expansion bolts] as indicated. Provide intermediate clip angles not over 1200 mm on centers. The top rung of the ladder must be level with the top of the access level, parapet or landing served by the ladder except for hatches or wells. Extend the side rails of through or side step ladders 105 centimeters above the access level. Provide ladder access protective swing gates at the top of access/egress level. The drawings must indicate ladder locations and details of critical dimensions and materials.

2.3.1 Phasing out of Ladder Cages and Wells (29 CFR 1910.28, Nov 2016)

Conform to JIS B 9713-4.
Each ladder installed before 19 November, 2018 shall be equipped with a personal fall arrest system, ladder safety device (climbing Ladder Fall Arrest System), cage, or well.

Each newly installed ladder over 6,000 mm in length shall only be equipped with a personal fall arrest system or climbing ladder fall arrest system (ladder safety device), cages and wells are prohibited. When a fixed ladder, cage, or well, or any portion of a section thereof, is replaced, a personal fall arrest system or climbing ladder fall arrest system (ladder safety device) is installed in at least that section of the fixed ladder, cage, or well where the replacement is located. On and after November 18, 2036, all fixed ladders shall only be equipped with a personal fall arrest system or a ladder safety device (climbing ladder Fall Arrest System).

2.3.2 Ladder Safety Devices (Climbing Ladder Fall Arrest Systems)

Conform to JIS B 9713-4. Install ladder safety devices on ladders over 6000 mm long or more. The ladder safety systems must meet the design requirement of the ladders which they serve. The ladder safety system must be capable of sustaining a minimum static load of 4.44kN. The applied loads transferred to the climbing ladder mounting locations as a result of a fall shall be specified by the manufacturer of the climbing ladder fall arrest system. Each ladder safety system must allow the worker to climb up and down using both hands and does not require the employee continuously, hold, push, or pull any part of the system while climbing. The connection between the carrier or lifeline and the point of attachment to the body harness does not exceed 23 cm. The ladder safety system consists of a rigid or flexible carrier. Mountings for the rigid carries are attached at each end of the carrier, with intermediate mountings spaced as necessary, along the entire length of the carrier. Mountings for flexible carrier are attached at each end of the carrier and cable guides for flexible carriers are installed at least 7.6 cm apart but not more than 12.2 m apart along the entire length of the carrier. The design and installation of mountings and cable guides does not reduce the design strength of the ladder.

2.3.3 Ship's Ladder

Fabricate stringers and framing of steel plate or shapes. Bolt, rivet or weld connections and anchor to supporting construction. Provide treads with non-slip surface as specified for safety treads. [Aluminum ladders may be provided, subject to approval of treads, materials, and shop drawings. Requirements shown or specified for steel apply. Provide anchor items of zinc-coated steel.] Design assembly, including tread connections and methods of attachment, to support a live load of 1300 N per tread. Provide railings as specified for metal handrails.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness.
3.2 WORKMANSHIP

Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion anchors, and powder-actuated fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine bolts, carriage bolts and powder-actuated threaded studs for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with JIS Z 3410. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5 FINISHES

3.5.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to JIS K 5674 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with JIS K 2208, asphalt-base emulsion.

3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

3.5.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than minus 15 degrees C above the dew point of the surrounding air, or when surface temperature is below 7 degrees C or over 35 degrees C, unless approved by the Contracting Officer.
3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. [Secure to masonry or concrete with not less than two 12 mm diameter expansion bolts.] Install intermediate clip angles not over 1200 mm on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. Ends of ladders must not rest upon [finished roof][floor].

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DIVISION 05 - METALS

SECTION 05 52 00

METAL RAILINGS

02/18

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)


JAPANESE STANDARDS ASSOCIATION (JSA)

JIS B 1111 (2017) Cross Recessed Machine Screws
JIS B 1112 (1995) Cross Recessed Head Wood Screws
JIS B 1189 (2014) Hexagon Bolt with Flange
JIS B 1251 (2018) Spring Lock Washers
JIS B 1256 (2008) Plain Washers
JIS F 2106 (2013) General Chain for Ships
JIS G 3101 (2017) Rolled Steels for General Structure (Amendment 1)
JIS G 3138 (2005) Rolled Steel Bars for Building Structure
JIS G 3444 (2016) Carbon Steel Tubes for General Structure
JIS G 3459 (2017) Stainless Steel Pipes (Amendment 1)
JIS G 3466 (2015) Carbon Steel Square and Rectangular Tubes for General Structure
JIS G 3475 (2014) Carbon Steel Tubes for Building Structure
JIS G 4051 (2018) Carbon Steels for Machine Structural Use (Amendment 1)
1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Preinstallation Meetings

Within [30] [_____] days of contract award, submit fabrication drawings [to the Contracting Officer] for the following items:

[ a. Iron and steel hardware ]
[b. Steel shapes, plates, bars and strips ]
[c. Steel railings and handrails ]
[d. Stainless Steel railings and handrails ]
[e. Aluminum railings and handrails ]
f. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

[a. Structural-steel plates, shapes, and bars
][b. Structural-steel tubing
][c. Cold-finished steel bars
][d. Hot-rolled carbon steel bars
][e. Cold-drawn steel tubing
][f. Concrete inserts
][g. Masonry anchorage devices
][h. Protective coating
][i. Steel railings and handrails
][j. Stainless Steel railings and handrails
][k. Aluminum railings and handrails
]  l. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Fabrication Drawings; G[, [_____]]
   Iron and Steel Hardware
   Steel Shapes, Plates, Bars and Strips

SD-07 Certificates
   Welding Procedures; G[, [_____]]
   Welder Qualification; G[, [_____]]

SD-08 Manufacturer's Instructions
   Installation Instructions
1.4 QUALITY CONTROL

1.4.1 Welding Procedures

[ Section 05 05 23.16 STRUCTURAL WELDING applies to work specified in this section.

] Submit results of welding procedures testing in accordance with JIS Z 3801 or JIS Z 3841 made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with JIS Z 3801 or JIS Z 3841, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, conduct an immediate retest of two test welds and ensure that each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

PART 2 PRODUCTS

2.1 DESIGN

Design all handrails and guards to resist a concentrated load of [890 N][ ] [_____] in any direction at any point of the top of the rail or[730 N/m][ ] [_____] applied horizontally to the top of the rail, whichever is more severe. Intermediate rails, balusters and panel fillers shall be design to resist a concentrated load of [220 N][ ]. MLIT Chapter 14, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts. [Provide series 300 stainless-steel pipe collars.]

In addition to the above loads exterior railings shall be also designed to withstand a wind load of [ ]N/m.

2.2 FABRICATION

Preassemble items in the shop to the greatest extent possible. Disassemble units only to the extent necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, before cleaning, treating, and applying surface finishes, including zinc coatings.

Provide railing and handrail detail plans and elevations at not less than 1 to 10 scale. Provide details of sections and connections at not less than 1 to 5 scale. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Use materials of size and thicknesses indicated or, if not indicated, of the size and thickness necessary to produce adequate strength and
durability in the finished product for its intended use. Work the materials to the dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use the type of materials indicated or specified for the various components of work.

Form exposed work true to line and level, with accurate angles and surfaces and straight sharp edges. Ensure that all exposed edges are eased to a radius of approximately 0.8 millimeter. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of JIS Z 3420 and JIS Z 3604. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form the exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use countersunk Phillips flathead screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.2.1 Aluminum Railings and Handrails

Fabrication: Provide fabrication jointing by one of the following methods:

a. Use flush-type rail fittings, welded and ground smooth with splice locks secured with 10 mm recessed-head set screws.

b. Ensure that mitered and welded joints made by fitting; post to top rail; intermediate rail to post; and corners, are groove welded and ground smooth. Where allowed by the Contracting Officer, provide butt splices reinforced by a tight-fitting dowel or sleeve not less than 150 mm in length. Tack-weld or epoxy-cement the dowel or sleeve to one side of the splice.

c. Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 6 or 10 mm stainless-steel recessed-head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to JIS H 5202.

[ Provide removable railing sections as indicated. [Provide toe-boards and brackets where indicated, using flange castings as appropriate.]

]2.2.2 Steel Railings and Handrails

Fabricate joint posts, rail, and corners by one of the following methods:

a. Flush-type rail fittings of commercial standard, welded and ground smooth, with railing splice locks secured with 10 mm
hexagonal-recessed-head setscrews.

b. Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove-welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight-fitting interior sleeve not less than 150 mm long.

c. Railings may be bent at corners in lieu of jointing, provided that bends are made in suitable jigs and the pipe is not crushed.

Provide removable sections as indicated.

][2.2.3 Stainless Steel Railings and Handrails

Provide stainless steel tubing, welded or seamless, conforming to JIS G 4304, JIS G 4305 or JIS G 3459 unless otherwise noted.

][2.2.4 Protective Coating

[ Shop-prime the steelwork as indicated in accordance with Section 09 90 00 PAINTS AND COATINGS except the following:

a. steel surfaces encased in concrete
b. steel surfaces for welding
c. high-strength bolt-connected contact surfaces
d. crane rail surfaces

][Provide hot-dipped galvanized steelwork as indicated in accordance with JIS H 8641. Touch up abraded surfaces and cut ends of galvanized members with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

]]2.3 COMPONENTS

][2.3.1 Structural Steel Plates, Shapes And Bars

Provide structural-size shapes and plates, except plates to be bent or cold-formed, conforming to JIS G 3101, unless otherwise noted.

Provide steel plates, to be bent or cold-formed, conforming to JIS G 3101, SS 400.

Provide steel bars and bar-size shapes conforming to JIS G 3101, unless otherwise noted.

][2.3.2 Structural-Steel Tubing

Provide structural-steel tubing, hot-formed, welded or seamless, conforming to JIS G 3466 unless otherwise noted.

][2.3.3 Hot-Rolled Carbon Steel Bars

Provide bars and bar-size shapes conforming to JIS G 3138, grade as selected by the fabricator.
2.3.4 Cold-Finished Steel Bars

Provide cold-finished steel bars conforming to JIS G 4051, grade as selected by the fabricator.

2.3.5 Cold-Drawn Steel Tubing

Provide tubing conforming to JIS G 3444, sunk-drawn, butt-welded, cold-finished, and stress-relieved.

2.3.6 Steel Pipe

Provide pipe conforming to JIS G 3466 STK 400 and 235 MPa or JIS G 3475, STKN400B and 235 MPa; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.3.7 Concrete Inserts

Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive M20 diameter machine bolts; either malleable iron conforming to JIS G 5705 or cast steel conforming to JIS G 5101, SC 42, SC 46 or SC 49, hot-dip galvanized in accordance with JIS B 1048.

Provide wedge-type concrete inserts consisting of galvanized box-type ferrous castings designed to accept M20 diameter bolts having special wedge-shaped heads, made of either malleable iron conforming to JIS G 5705 or cast steel conforming to JIS G 5101 and hot-dip galvanized in accordance with JIS B 1048.

Provide carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims, galvanized in accordance with JIS B 1048. Provide slotted-type concrete inserts consisting of a galvanized 3 millimeter thick pressed-steel plate conforming to JIS G 3101 SS41 or SB35, made of box-type welded construction with a slot designed to receive M20 diameter square-head bolt with knockout cover; and hot-dip galvanized in accordance with JIS H 8641.

2.3.8 Fasteners

Provide galvanized zinc-coated fasteners in accordance with JIS B 1048 used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ISO 898-1.

Provide square-head lag bolts conforming to JIS B 1189.

Provide cadmium-plated steel machine screws conforming to JIS B 1111.

Provide flat-head carbon steel wood screws conforming to JIS B 1112.

Provide plain round, general-assembly-grade, carbon steel washers conforming to JIS B 1256.

Provide helical spring, carbon steel lockwashers conforming to JIS B 1251.
2.3.9 Steel Railings and Handrails

2.3.9.1 Steel Handrails

Provide steel handrails, including inserts in concrete, [steel pipe conforming to JIS G 3466] [or] [structural tubing conforming to JIS G 3466]. Provide steel railings of [40] [50] mm nominal size, [hot-dip galvanized] [and] [shop-painted].

Provide kickplates between railing posts where indicated and consisting of 4 millimeter steel flat bars not less than 150 millimeter high. Secure kickplates as indicated.

[Galvanize exterior railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings.]

[Provide galvanized exterior and interior railings where indicated, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings not indicated as galvanized.]

[Provide galvanized railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components.]

2.3.10 Aluminum Railings and Handrails

Provide railings and handrails consisting of [40] [50] mm nominal schedule 40 pipe JIS H 4100, 45 mm aluminum semi hollow tube with rounded corners JIS H 4040. Provide [mill-finish] [anodized] aluminum [_____] color railings. Ensure that all fasteners are Series 300 stainless steel.

2.3.11 Safety Chains [and Guardrails]

Provide safety chains of galvanized steel, straight-link type, 5 mm diameter, with at least 12 links per 300 mm, and with snap hooks on each end. Test safety chain in accordance with JIS F 2106. Provide snap hooks of boat type. Provide galvanized 10 mm bolt with 20 mm eye diameter for attachment of chain, anchored as indicated. Supply two chains, 100 mm longer than the anchorage spacing, for each guarded area. Locate [guardrails] safety chain where indicated. Mount the top chain [rail] 1050 mm [_____] above the [floor] [ground] and mount the lower chain [rail] 600 mm [_____] above the [floor] [ground].

PART 3 EXECUTION

3.1 PREPARATION

Adjust stair railings and handrails before securing in place in order to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than [2440 millimeter] [_____] on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

[a. Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard-weight, steel pipe, not less than 150 millimeter long, and having an inside diameter not less than 13 millimeter greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom]
of the sleeve, with closure width and length not less than 25 millimeter greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between the post and sleeve with non-shrink grout or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.

] [b. Anchor posts to steel with oval steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

] [c. Anchor rail ends into concrete and masonry with round steel flanges welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

] [d. Anchor rail ends to steel with oval or round steel flanges welded to tail ends and bolted to the structural-steel members.

] Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets of malleable iron castings, with not less than 75 millimeter projection from the finished wall surface to the center of the pipe, drilled to receive one M10 bolt. Locate brackets not more than 1525 millimeter on center. Provide wall return fittings of cast iron castings, flush type, with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

[ a. For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

] [b. For hollow masonry and stud partition anchorage, use toggle bolts having square heads.

] Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of [steel] [_____] [stair railing] [and] [hand rail work]:

[ a. Structural-steel plates, shapes, and bars

][b. Structural-steel tubing

][c. Cold-finished steel bars

][d. Hot-rolled carbon steel bars

][e. Cold-drawn steel tubing

][f. Protective coating

][g. Masonry anchorage devices

][h. Steel railings and handrails

][i. Aluminum railings and handrails
[j. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications cited in this section.

[3.2.1 Steel Handrail

Install handrail [in pipe sleeves embedded in concrete and filled with non-shrink grout or quick-setting anchoring cement with anchorage covered with standard pipe collar pinned to post.][by means of pipe sleeves secured to wood with screws.][by means of masonry with expansion shields and bolts or toggle bolts.][by means of base plates bolted to stringers or structural-steel framework.][anchored by expansion shields and bolts.][through-bolted to a back plate or by 6 mm lag bolts to studs or solid backing.]

[3.2.2 Aluminum Handrail

Affix to base structure by [flanges anchored to concrete or other existing masonry by expansion shields][base plates or flanges bolted to stringers or structural-steel framework][flanges through-bolted to a backing plate on the other side of a wall][flanges lag-bolted to studs or other structural timbers]. Provide Series 300 stainless-steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, coat the contact surface with a heavy coating of bituminous paint.

[3.2.3 Touchup Painting

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 0.051 millimeter.

[3.3 FIELD QUALITY CONTROL

3.3.1 Field Welding

Ensure that procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply with JIS Z 3410, JIS Z 3420, or JIS Z 3604.

-- End of Section --
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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


INTERNATIONAL STANDARDS ORGANIZATION (ISO)


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 5905       (2014) Fiberboards

JIS A 5908       (2015) Particleboards


JIS K 6903       (2008) Laminated Thermosetting High-Pressure Decorative Sheets

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORTATION AND TOURISM (MLIT)


1.2 SYSTEM DESCRIPTION

Work in this section includes laminate clad custom casework [cabinets] [vanities] [_____] as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
  Shop Drawings
  Installation
SD-03 Product Data
  Finish Schedule
SD-04 Samples
  Plastic Laminates
  Cabinet Hardware
SD-07 Certificates

1.4 QUALITY ASSURANCE

1.4.1 General Requirements

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the [premium] [custom] grade quality standards as outlined in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Submit a quality control statement which illustrates compliance with and understanding of project requirements. The quality control statement shall also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

1.5 DELIVERY, STORAGE, AND HANDLING

Casework may be delivered knockdown or fully assembled. Deliver all units to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.
PART 2  PRODUCTS

2.1  WOOD MATERIALS

2.1.1  Lumber

a. All framing lumber shall be kiln-dried with moisture content 6 to 8 percent, to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 15 mm to 19 mm hardwood.

b. Standing or running trim casework components, which are specified to receive a transparent finish, shall be [_____] hardwood species, plain sawn. Grade shall be [premium] [custom]. Location, shape, and dimensions shall be as indicated on the drawings.

2.1.2  Panel Products

2.1.2.1  Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.1.2.2  Particleboard

All particleboard shall be industrial grade, medium density (640 to 800 kg per cubic meter), 15 mm to 19 mm thick. A moisture-resistant particleboard shall be used as the substrate for plastic laminate covered [countertops] [backsplashes] [_____] [components as located on the drawings] and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in JIS A 5908.

2.1.2.3  Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in JIS A 5905.

2.2  SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06 61 16 SOLID SURFACING FABRICATIONS.

2.3  HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of JIS K 6903 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on [the drawings]. Submit two samples of each plastic laminate pattern and color. Samples shall be a minimum of 120 by 170 mm in size. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1  Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.95 mm to 1.2 mm in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.
2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.55 mm to 0.7 mm in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 0.95 mm to 1.2 mm in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.3.4 Vertical General Purpose Postformable (VGP) Grade

Vertical general purpose postformable grade plastic laminate shall be 0.7 mm in thickness. This laminate grade is intended for exposed exterior vertical surfaces of components where postforming is required for curved surfaces.

2.3.5 Horizontal General Purpose Fire Rated (HGF) Grade (U.S. Product only)

Horizontal general purpose fire rated grade plastic laminate shall be 1.22 mm (plus or minus 0.127 mm) in thickness. Laminate grade shall have a class 1, class A fire rating in accordance with ASTM E84.

2.3.6 Vertical General Purpose Fire Rated (VGF) Grade

Vertical general purpose fire rated grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade shall have a class 1, class A fire rating in accordance with ASTM E84.

2.3.7 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.55 mm in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.3.8 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.51 mm. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for [casework cabinet interior] [drawer interior] [all semi-exposed] [_____] surfaces.

2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be [0.5 mm] [3 mm] [_____] thick. Material width shall be [as indicated on the drawings] [______]. Color and pattern shall [match exposed door and drawer front laminate pattern and color] [be as indicated on the drawings] [______].
2.6 CABINET HARDWARE

Submit one sample of each cabinet hardware item specified to include [hinges], [pulls], [drawer glides], and [______]. All hardware shall follow the requirements to MLIT SS Chapter 12, unless otherwise noted, and shall consist of the following components:

2.6.1 Door Hinges
[______] type.

2.6.2 Cabinet Pulls
[______] type.

2.6.3 Drawer Slide
Side mounted [______] type, with [full] [______] extension and a minimum [34 kg] [45 kg] [______] load capacity. Slides shall include an [integral] [positive] stop to avoid accidental drawer removal.

2.6.4 Adjustable Shelf Support System
[Recessed (mortised) metal standards, finish: [______]. Support clips for the standards shall be [open type,] [closed type,] finish: [______]] [Multiple holes with [metal] [plastic] [wood] pin supports].

2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to JIS B 1099 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by manufacturer. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations and JIS A 1901 regarding VOC emissions and off-gassing.

2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be for interior use [urea-formaldehyde resin formula] [polyvinyl acetate resin emulsion] [______]. Adhesives shall withstand a bond test as described in MLIT SS Chapter 12.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be [a water-based contact adhesive] [______] [adhesive consistent with AWI and laminate manufacturer's recommendations]. PVC edgebanding shall be adhered using a polymer-based hot melt glue.
2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.9 WOOD FINISHES

Paint, stain, varnish and their applications required for laminate clad casework components shall be [_____] [as indicated in Section 09 90 00 PAINTS AND COATINGS] [as indicated in Section 09 06 00 SCHEDULES FOR FINISHES]. Color and location shall be as indicated on the drawings.

2.10 ACCESSORIES

2.10.1 Glass and Glazing

Glass required in laminated casework shall be referenced by type in accordance with Section 08 81 00 GLAZING. Glass shall be one of the following:

a. Type [A] [______].

b. [Float] [Patterned] glass: [Clear] [pattern] quality.

c. Safety glass: [Clear] [______]; [heat strengthened] [fully tempered] [laminated] [______]; [_____] mm thick minimum.

d. Wire Glass: [Clear] [______], polished [both sides] [one side]; [square] [diagonal] [______] mesh woven stainless steel wire of grid [______] mm size; [_____] mm thick.

2.10.2 Grommets

Grommets shall be [plastic] [metal] [rubber] [______] material for cutouts with a diameter of [_____] mm. Locations shall be as indicated on the drawings.

2.11 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI [premium] [custom] grade unless otherwise indicated in this specification. Cabinet style, shall be [flush overlay] [reveal overlay] [flush inset without face frame] [flush inset with face frame] [as indicated on the drawings].
2.11.1 Base and Wall Cabinet Case Body

2.11.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

2.11.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

15 mm to 20 mm [veneered particleboard per JIS A 5908] [medium density fiberboard (MDF)] [veneer core plywood] panel product

2.11.1.1.2 Face Frames and Rails

15 mm to 20 mm [hardwood lumber] [panel product]

2.11.1.1.3 Shelving

15 mm to 20 mm [veneered particleboard per JIS A 5908 or ISO 16893] [medium density fiberboard (MDF)] [veneer core plywood] panel product

2.11.1.1.4 Cabinet Backs

5 mm [veneered particleboard per JIS A 5908 or ISO 16893] [medium density fiberboard (MDF)] [veneer core plywood] panel product

2.11.1.1.5 Drawer Sides, Backs, and Subfronts

13 mm [hardwood lumber] [panel product]

2.11.1.1.6 Drawer Bottoms

5 mm [veneered particleboard per JIS A 5908 or ISO 16893] [medium density fiberboard (MDF)] [veneer core plywood] panel product

2.11.1.1.7 Door and Drawer Fronts

15 mm to 20 mm [veneered particleboard] [medium density fiberboard (MDF)] panel product

2.11.1.2 Joinery Method for Case Body Members

2.11.1.2.1 Tops, Exposed Ends, and Bottoms

a. Steel "European" assembly screws (37 mm from end, 128 mm on center, fasteners will not be visible on exposed parts).

b. Doweled, glued under pressure (approx. 4 dowels per 300 mm of joint).

c. Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

d. Spline or biscuit, glued under pressure.
2.11.1.2.2 Exposed End Corner and Face Frame Attachment

2.11.1.2.2.1 Mitered Joint

Lock miter or spline or biscuit, glued under pressure (no visible fasteners)

2.11.1.2.2.2 Non-Mitered Joint (90 degree)

Butt joint glued under pressure (no visible fasteners)

2.11.1.2.2.3 Butt Joint

Glued and nailed

2.11.1.2.3 Cabinet Backs (Wall Hung Cabinets)

Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

2.11.1.2.3.1 Full Bound

Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

2.11.1.2.3.2 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 13 mm and minimum No. 12 plated (no case hardened) screws spaced a minimum 80 mm on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

2.11.1.2.3.3 Side Bound

Side bound, captured in groove or rabbetts; glued and fastened.

2.11.1.2.4 Cabinet Backs (Floor Standing Cabinets)

2.11.1.2.4.1 Side Bound

Side bound, captured in grooves; glued and fastened to top and bottom.

2.11.1.2.4.2 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 13 mm and minimum No. 12 plated (no case hardened) screws spaced a minimum 80 mm on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

2.11.1.2.4.3 Side Bound with Rabbetts

Side bound, placed in rabbetts; glued and fastened in rabbetts.

2.11.1.2.5 Wall Anchor Strips

Wall Anchor Strips shall be required for all cabinets with backs less than 13 mm thick. Strips shall consist of minimum 13 mm thick lumber, minimum
60 mm width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.11.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of [nominal 50 mm thick lumber] [19 mm particleboard] [19 mm fiberboard] [19 mm veneer core exterior plywood]. Base assembly components shall be [treated lumber] [a moisture-resistant panel product]. Finished height for each cabinet base shall be [not less than the full height of the installed, specified wall base] [as indicated on the drawings]. Bottom edge of the cabinet door or drawer face shall [be flush with top of base] [extend below the top of the base as indicated on the drawings].

2.11.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from [15 mm medium density particleboard] [15 mm medium density fiberboard (MDF)]. All door and drawer front edges shall be surfaced with [high pressure plastic laminate] [PVC edgebanding], color and pattern [to match exterior face laminate] [as indicated on the drawings] [as indicated in Section 09 06 00 SCHEDULES FOR FINISHES].

2.11.4 Drawer Assembly

2.11.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

2.11.4.1.1 Drawer Sides and Backs For Transparent Finish

13 mm thick [solid hardwood lumber] [7-ply hardwood veneer core plywood (no voids), any species]

2.11.4.1.2 Drawer Sides and Backs For Laminate Finish

13 mm thick 7-ply hardwood veneer core substrate

2.11.4.1.3 Drawer Sides and Back For Thermoset Decorative Overlay (Melamine) Finish

13 mm thick medium density particleboard or MDF fiberboard substrate

2.11.4.1.4 Drawer Bottom

6 mm thick [veneer core panel product for transparent or plastic laminate finish] [thermoset decorative overlay melamine panel product]

2.11.4.2 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.
d. Bottoms shall be set into sides, front, and back, 6 mm deep groove with a minimum 9 mm standing shoulder.

2.11.5 Shelving

2.11.5.1 General Requirements

Shelving shall be fabricated from [15 mm medium density particleboard] [15 mm medium density fiberboard (MDF)] [15 mm veneer core plywood]. All shelving top and bottom surfaces shall be finished with [HPDL plastic laminate] [thermoset decorative overlay (melamine)]. Shelf edges shall be finished in a [HPDL plastic laminate] [thermoset decorative overlay (melamine)] [PVC edgebanding].

2.11.5.2 Shelf Support System

The shelf support system shall be:

2.11.5.2.1 Recessed (Mortised) Metal Shelf Standards

Mortise standards flush with the finishes surface of the cabinet interior side walls, two per side. Position and space standards on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Install and adjust standards vertically to provide a level, stable shelf surface when clips are in place.

2.11.5.2.2 Pin Hole Method

Drill holes on the interior surface of the cabinet side walls. Evenly space holes in two vertical columns. Space the holes in each column at [25 mm] [_____] increments starting [150 mm] [_____] from the cabinet interior bottom and extending to within [150 mm] [_____] of the top interior surface of the cabinet. Drill holes to provide a level, stable surface when the shelf is resting on the shelf pins. Coordinate hole diameter with pin insert size to provide a firm, tight fit.

2.11.6 Edge Style

Front [and exposed side] countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be:

2.11.6.1 Post Formed Plastic Laminate

Laminate edge shall be integral with countertop surface. Shape and profile shall be [bullnose] [waterfall] [as indicated] [_____] and to dimensions as indicated.

2.11.6.2 Hardwood

Species, finish, profile, shape, and dimensions shall be as indicated on the drawings. Hardwood edge shall overlap the exposed countertop laminate edge and shall be installed flush with the countertop laminate surface.

2.11.6.3 Vinyl

Vinyl tee-mould edge shall be in shape, thickness, and color as indicated on the drawings. Tee mould edge shall overlap the exposed countertop laminate edge and shall be installed flush with the countertop laminate surface.
2.11.6.4 Plastic Laminate Self Edge

Flat, 90 degree "self" edge. Edge must be applied before top. Laminate edge shall overlap countertop laminate and shall be eased to eliminate sharp corners.

2.11.7 Laminate Clad Splashes

Countertop splash substrate shall be 20 mm [particleboard] [MDF fiberboard] [veneer core plywood]. Laminate clad backsplash shall be [integral with countertop, coved to radius and to dimensions as indicated on the drawings] [loose, to be installed at the time of countertop installation]. Side splashes shall be straight profile and provided loose, to be installed at the time of countertop installation. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

2.11.8 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and JIS K 6903, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to laminate types and grades for component surfaces and shall be as follows unless otherwise indicated on the drawings:

2.11.8.1 Base/Wall Cabinet Case Body

a. Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade [VGS] [VGP].

b. Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: [HPDL Grade CLS] [Thermoset Decorative Overlay (melamine)].

2.11.8.2 Adjustable Shelving

2.11.8.2.1 Top and Bottom Surfaces

[HPDL Grade HGS] [Thermoset Decorative Overlay (melamine)]

2.11.8.2.2 All Edges

[HPDL Grade VGS] [Thermoset Decorative Overlay (melamine)][PVC edgebanding]

2.11.8.3 Fixed Shelving

2.11.8.3.1 Top and Bottom Surfaces

[HPDL Grade HGS] [Thermoset Decorative Overlay (melamine)]
2.11.8.3.2 Exposed Edges

[HPDL Grade VGS] [Thermoset Decorative Overlay (melamine)] [PVC edgebanding]

2.11.8.4 Door, Drawer Fronts, Access Panels

2.11.8.4.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces

HPDL Grade [VGS] [VGP]

2.11.8.4.2 Edges

[HPDL Grade VGS] [PVC edgebanding]

2.11.8.5 Drawer Assembly

All interior and exterior surfaces: [HPDL Grade CLS] [Thermoset Decorative Overlay (melamine)].

2.11.8.6 Countertops and Splashes

All exposed and semi-exposed surfaces: HPDL Grade HGS

2.11.8.7 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the [premium] [custom] grade requirements.

2.11.9 Finishing

2.11.9.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.11.9.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

2.11.9.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09 90 00 PAINTS AND COATINGS. All cabinet reveals shall be painted. Submit descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.
PART 3  EXECUTION

3.1  INSTALLATION

Installation shall comply with applicable requirements for [premium] [custom] quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1  Anchoring Systems

3.1.1.1  Floor

[Base cabinets] [_____] shall utilize a floor anchoring system [as detailed on the drawings]. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. [Cabinet] [_____] assemblies shall be attached to anchored bases without visible fasteners [as indicated in the drawings]. Where assembly abuts a wall surface, anchoring shall include a minimum 13 mm thick lumber or panel product hanging strip, minimum 60 mm width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2  Wall

[Cabinet] [vanity] [_____] to be wall mounted shall utilize minimum 13 mm thick lumber or panel product hanging strips, minimum 60 mm width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2  Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk. Loose [back] [side] splashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks.

3.1.3  Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 5 mm "Euroscrews". The use of wood screws without insertion dowels is prohibited.

3.1.4  Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with [premium] [custom] grade requirements.
3.1.5 Plumbing Fixtures

Install sinks, sink hardware, and other plumbing fixtures in locations as indicated on the drawings and in accordance with [Section 22 00 00 PLUMBING, GENERAL PURPOSE] [_____].

3.1.6 Glass

Install glass and glazing in the casework using methods and materials specified in Section 08 81 00 GLAZING in locations as indicated on the drawings.

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FLUID-APPLIED WATERPROOFING

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE ARCHITECTURAL STANDARD SPECIFICATION (JASS)

JASS 8 Waterproofing Work Standard Specification

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5005 (2009) Crushed Stone and Manufactured Sand for Concrete

JIS A 6013 (2014) Polymer-Modified Bitumen Roofing Sheets

JIS A 6021 (2011) Liquid-applied Compounds for Waterproofing Membrane Coatings of Buildings

JIS A 9521 (2017) Thermal Insulation Materials for Buildings

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM, GOVERNMENT OF JAPAN (MLIT)


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fluid-Applied Membrane

Membrane Primer

Bond Breaker
Submit material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To Government Personnel

Include copies of Safety Data Sheets for maintenance/repair materials.

1.3 PREWATERPROOFING CONFERENCE

Prior to starting application of waterproofing system, arrange and attend a prewaterproofing conference to ensure a clear understanding of drawings and specifications. Give the Contracting Officer 7 days advance written notice of the time and place of meeting. Ensure that the mechanical and electrical subcontractor, flashing and sheetmetal subcontractor, and other trades that may perform other types of work on or over the membrane after installation, attend this conference.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by a referenced specification number shall bear the specification number, type, and class of the contents. Deliver materials in sufficient quantity to continue work without interruption. Store and protect materials in accordance with manufacturer's instructions, and use within their indicated shelf life. When hazardous materials are involved, adhere to special precautions of the manufacturer, unless precautions conflict with local, state, and federal regulations. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture or freezing. Store materials on pallets and cover from top to bottom with canvas tarpaulins.

1.5 ENVIRONMENTAL CONDITIONS

Apply materials when ambient temperature is 4 degrees C or above for a period of 24 hours prior to the application and when there is no ice, frost, surface moisture, or visible dampness on the substrate surface. Apply materials when air temperature is expected to remain above 4 degrees C during the cure period recommended by the manufacturer. Moisture test for substrate is specified under paragraph entitled "Moisture Test." Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum of 4 degrees C for 24 hours prior to the application of the waterproofing, and remains above that temperature during the cure period recommended by the manufacturer.

1.6 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revisions or amendment to standard membrane manufacturer warranty to comply with the specified requirements. Minimum
manufacturer warranty shall have no dollar limit, cover full system water-tightness, and shall have a minimum duration of 10 years.

1.6.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 10-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Write the warranty directly to the Government commencing at time of Government's acceptance of the roof work. Provide the following statements for such warranty:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All cost associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. The warranty must remain in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification.

1.6.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.6.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.7 CONFORMANCE AND COMPATIBILITY

Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the MLIT SS Chapter 9, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction.
PART 2   PRODUCTS

2.1  FLUID-APPLIED MEMBRANE

JIS A 6021 and comply with JASS 8.

2.2  MEMBRANE PRIMER

As recommended by the fluid-applied membrane manufacturer unless specifically prohibited by the manufacturer of the fluid-applied membrane.

2.3  SEALANT

As specified in Section 07 92 00 JOINT SEALANTS.

2.4  SEALANT PRIMER

As specified in Section 07 92 00 JOINT SEALANTS.

2.5  BACKING MATERIAL

Premolded, closed-cell, polyethylene, or polyurethane foam rod having a diameter 25 percent larger than joint width before being compressed into joint. Provide bond breaker of polyethylene film or other suitable material between backing material and sealant.

2.6  [JOINT FILLER]

As specified in [Section 03 30 00 CAST-IN-PLACE CONCRETE.]

2.7  BOND BREAKER

As recommended by the fluid-applied membrane manufacturer. Bond breaker shall not interfere with the curing process or other performance properties of the fluid-applied membrane.

2.8  ELASTOMERIC SHEET

Preformed; as recommended by the fluid-applied membrane manufacturer. Bond strength between the fluid-applied membrane and the preformed elastomeric sheet shall be a minimum of 7 kPa when tested in accordance with JIS A 6013.

2.9  ELASTOMERIC SHEET ADHESIVE

As recommended by the elastomeric sheet manufacturer.

2.10  PROTECTION BOARD

Premolded bitumen composition board, 3 mm minimum thickness or other composition board compatible with the fluid-applied membrane.

2.11  DRAINAGE COURSE AGGREGATE

JIS A 5005, size 9.5 mm to 2.5 mm.

2.12  INSULATION

Polystyrene foam conforming to JIS A 9521, thickness as [indicated] [required by indicated R-value].
PART 3   EXECUTION

3.1   PREPARATION

Coordinate work with that of other trades to ensure that components to be incorporated into the waterproofing system are available when needed. Inspect and approve surfaces immediately before application of waterproofing materials. Remove laitance, loose aggregate, sharp projections, grease, oil, dirt, curing compounds, and other contaminants which could adversely affect the complete bonding of the fluid-applied membrane to the concrete surface.

3.1.1   Flashings

Make penetrations through sleeves in concrete slab watertight before application of waterproofing. After flashing is completed, cover elastomeric sheet with fluid-applied waterproofing during waterproofing application.

3.1.1.1   Drains

Make drain flanges flush with surface of structural slab. Apply a full elastomeric sheet around the drain, with edges fully adhered to drain flange and to structural slab. Do not adhere elastomeric sheet over joint between drain and concrete slab. Do not plug drainage or weep holes. Cover elastomeric sheet with fluid-applied waterproofing during waterproofing application. Lap elastomeric sheet a minimum of 100 mm onto concrete slab.

3.1.1.2   Penetrations and Projections

Flash penetrations and projections through structural slab with an elastomeric sheet adhered to the concrete slab and the penetration. Leave elastomeric sheet unadhered for 25 mm over joint between penetration and concrete slab. Adhere elastomeric sheet a minimum of 100 mm onto horizontal deck.

3.1.1.3   Walls and Vertical Surfaces

Flash wall intersections which are not of monolithic pour or constructed with reinforced concrete joints with an elastomeric sheet adhered to both vertical wall surfaces and concrete slab. Flash intersections which are monolithically poured or constructed with reinforced concrete joints with either an elastomeric sheet or a vertical grade of fluid-applied waterproofing adhered to vertical wall surfaces and concrete slab. Leave sheet unadhered for a distance of 25 mm from the corner on both vertical and horizontal surfaces.

3.1.2   Cracks and Joints

Prepare visible cracks and joints in substrate to receive fluid-applied waterproofing membrane by placing a bond breaker and an elastomeric slip sheet between membrane and substrate. Cracks that show movement shall receive a 50 mm bond breaker followed by an elastomeric sheet adhered to the deck. Nonmoving cracks shall be double coated with fluid-applied waterproofing.
3.1.3 Priming

Prime surfaces to receive fluid-applied waterproofing membrane. Apply primer as required by membrane manufacturer's printed instructions.

3.2 SPECIAL PRECAUTIONS

Protect waterproofing materials during transport and application. Do not dilute primers and other materials, unless specifically recommended by materials manufacturer. Keep containers closed except when removing contents. Do not mix remains of unlike materials. Thoroughly remove residual materials before using application equipment for mixing and transporting materials. Do not permit equipment on the project site that has residue of materials used on previous projects. Use cleaners only for cleaning, not for thinning primers or membrane materials. Ensure that workers and others who walk on cured membrane wear clean, soft-soled shoes to avoid damaging the waterproofing materials.

3.3 APPLICATION

Over primed surfaces, provide a uniform, wet, monolithic coating of fluid-applied membrane, 1.5 mm thick, plus or minus 0.125 mm by following manufacturer's printed instructions. Apply material by trowel, squeegee, roller, brush, spray apparatus, or other method recommended by membrane manufacturer. Check wet film thickness as specified in paragraph entitled "Film Thickness" and adjust application rate as necessary to provide a uniform coating of the thickness specified. Where possible, mark off surface to be coated in equal units to facilitate proper coverage. At expansion joints, control joints, prepared cracks, flashing, and terminations, carry membrane over preformed elastomeric sheet in a uniform 1.5 mm thick, plus or minus 0.125 mm, wet thickness to provide a monolithic coating. If membrane cures before next application, wipe previously applied membrane with a solvent to remove dirt and dust that could inhibit adhesion of overlapping membrane coat. Use solvent recommended by the membrane manufacturer, as approved.

3.3.1 Work Sequence

Perform work so that protection board is installed prior to using the waterproofed surface. Do not permanently install protection board until the membrane has passed the flood test specified under paragraph entitled "Flood Test." Move material storage areas as work progresses to prevent abuse of membrane and overloading of structural deck.

3.3.2 Protection Board

Protect fluid-applied membrane by placing protection board over membrane at a time recommended by the membrane manufacturer. Protect membrane application when protection board is not placed immediately. Butt protection boards together and do not overlap.

3.3.3 Drainage Course

Place drainage course where shown after flood tests are completed and concrete protection slab or wearing course is ready to be installed.

3.3.4 Insulation

Place insulation of thickness indicated, on top of drainage course just
prior to placement of concrete protection slab.

3.4 FIELD QUALITY CONTROL

3.4.1 Moisture Test

Prior to application of fluid-applied waterproofing, measure moisture content of substrate with a moisture meter in the presence of the Contracting Officer. Do not begin application until meter reading indicates "dry" range.

3.4.2 Film Thickness

Measure wet film thickness every 10 square meters during application by placing flat metal plates on the substrate or using a mil-thickness gage especially manufactured for the purpose.

3.4.3 Flood Test

After application and curing is complete, plug drains and fill waterproofed area with water to a depth of 50 mm. A minimum 48 hour cure time, or longer cure time if recommended by the membrane manufacturer, shall be required prior to flood testing. Allow water to stand 24 hours. Test watertightness by measuring water level at beginning and end of the 24 hour period. If water level falls, drain water, allow installation to dry, and inspect. Make repairs or replace as required and repeat the test. Work shall not proceed before approval of repairs or replacement.

3.5 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.6 INFORMATION CARD

For each roof application, furnish a minimum 215 mm information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm thick aluminum card for exterior display. Identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contract information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.
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<td>3. Project Specification Designation</td>
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SECTION 07 52 00

MODIFIED BITUMINOUS MEMBRANE ROOFING

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MODIFIED BITUMINOUS MEMBRANE ROOFING
05/12

PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


ASTM INTERNATIONAL (ASTM)

ASTM E108 (2011) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470 (2010) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction


INTERNATIONAL CODE COUNCIL (ICC)


JAPANESE STANDARD ASSOCIATION (JSA)

JIS A 6005 (2005) Asphalt Roofing Felts


JIS A 6013 (2014) Polymer-Modified Bitumen Roofing Sheets

JIS A 6022 (2010) Stretchy Asphalt Roofing Felts (Synthetic Fiber Base)

JIS A 9521 (2017) Thermal Insulation Materials for Buildings

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM, GOVERNMENT OF JAPAN (MLIT)

1.2 DESCRIPTION OF ROOF MEMBRANE SYSTEM[S]

[ [Minimum [two-ply][three-ply] SBS [or] [APP] [modified bitumen roof membrane consisting of [modified bitumen base sheet][fiberglass felt [venting ]base sheet] [,interply sheet] and cap sheet. Modified bitumen roof membrane must be [set in hot asphalt][torch applied][set in cold-applied adhesive].]


] All work must follow the manufacturer guidelines and standards stated within this Section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Roof plan; G[, [_____] ] drawing depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, as applicable

SD-07 Certificates

Fire Resistance classification; G[, [_____] ]

Submit the roof system assembly fire rating classification listings.

SD-11 Closeout Submittals

Warranty

Information Card

Instructions To [Government][Contractor] Personnel

Include copies of Safety Data Sheets for maintenance/repair materials.

Submit 20 year "No-Dollar-Limit" warranty for labor and materials.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer must have a minimum of [5][_____] years experience in manufacturing modified bitumen roofing products.

1.4.2 Qualification of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the modified bitumen sheet roofing system manufacturer and have a minimum of [five][_____] years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. The applicator must supply the names, locations and client contact information of five projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years. Applicator must be certified technician with Japan Roofing Contractors Association.

1.4.3 Qualifications of Photovoltaics (PV) Rooftop Applicator

The PV rooftop applicator must be approved, authorized, or certified by a Roof Integrated Solar Energy (RISE) Certified Solar Roofing Professional (CSRP), and comply with applicable codes, standards, and regulatory requirements to maintain the weatherproofing abilities of both the integrated roof system and photovoltaic system.

1.4.4 Qualification of Engineer of Record

[ Engineer of Record must be currently licensed within the jurisdiction of the project.

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Engineer of Record must be approved, authorized, and currently licensed by the state of [Florida], and have a minimum of five years experience as an approved Engineer for manufacturers of similar roof systems. Engineer of Record must supply the names and locations of five projects of similar size and scope for which he has provided engineering calculations using the manufacturer's products submitted for this project within the previous three years. Engineer of Record must provide certified engineering calculations for:

1. ASCE 7, in accordance with International Building Code.

   - Seismic requirements per [local] [and state] building codes

   - Seismic requirements per ICC IBC Chapter 16, Section 1608.3

   - Snow load requirements per ICC IBC Chapter 16 Section 1608.3 and Section 7 of ASCE 7

2. Fire Resistance

   Complete roof covering assembly must:

   a. Be Class A [or B] rated in accordance with ASTM E108, FM 4470, or UL 790; and

   b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM APP GUIDE.

   FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

3. Wind Uplift Resistance

   Provide a complete roof system assembly that is rated and installed to resist wind loads [indicated] [calculated in accordance with ASCE 7] and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems, except as approved by the Contracting Officer. Submit licensed engineer's Wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed of [_____] km/h in accordance with ASCE 7 and other applicable building code requirements.

4. Preroofing Conference

   After approval of submittals and before performing roofing [and insulation] system installation work, hold a preroofing conference to review the following:

   a. Drawings, including Roof Plan, specifications and submittals related to the roof work

   [ Field inspection and verification of all existing conditions, including all fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.

   b. Roof system components installation
c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roof structure, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing

e. Quality control, (ARMA PMBRG98) plan for the roof system installation

f. Safety requirements

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, and personnel directly responsible for the installation of roofing [and insulation], flashing and sheet metal work, [mechanical] [and] [electrical] work, other trades interfacing with the roof work, designated safety personnel trained to enforce and comply with [Fire Marshall], and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification, the container must bear the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 10 degrees C for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

Maintain a minimum distance of 10.67 meters for all stored flammable materials, including materials covered with shrink wraps, craft paper or tarps from all torch/welding applications.
Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.5.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 4.44 degrees C, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow manufacturer's printed instructions for Cold Weather Installation.

[1.7 [TORCH][HOT-MOPPED ASPHALT] APPLIED [(HEAT WELD)] MODIFIED BITUMEN MEMBRANE SAFETY

1.7.1 Property Protection

Take all precautions necessary to prevent ignition of combustible materials during [hot-mopped asphalt application] of roofing. Immediately call the fire department if a fire commences. Review all fire safety procedures as outlined at the pre-roofing conference.


Do not store flammable liquids on the roof.

No Asphalt Kettles are allowed on roofs. Locate kettles and supply LP-Gas Cylinders safely and secured per NFPA 241 outside of the building’s perimeter a minimum of 6.096 m from the structure and any combustible materials.

Maintain a minimum separation of 6.096 m between LP-Gas Cylinders and kettle. Provide protective fire retardant blanket barrier or shield between any building structure to a minimum height of 8 foot and a clear surround distance of 2.44 m if operations force placement of kettle within a distance of 6.096 m. Do not obstruct or place kettles or Cylinder storage within 3.048 m of exits, means of egress, gates, roadways, entrances. Locate kettles downwind and away from any building air intakes.

Provide a minimum of two portable fully charged [ 9.072 kg CO2] [ 9.072 kg ABC (dry chemical)] fire extinguishers no closer than 1.524 m and no further than 7.62 m of horizontal travel distance from each kettle at all times while kettle is in operation, in easily accessible and identifiable locations. Also provide [a minimum of one][two] multipurpose 2-A:20-B:C portable fire extinguisher on the roof being covered or repaired.

Comply with the following safety procedures:

a. Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating must comply with the requirements of NFPA 58.
b. Fuel containers having capacities greater than one pound must be located a minimum of 3.048 m clear distance from the burner flame.

c. Clearly label all LP-Gas Cylinders as "Flammable Gas", and secure to prevent accidental tip-over.

d. Check all pressure regulators and hoses prior to use for proper functioning and integrity.

e. Turn off fuel supply at LP Gas Cylinder when kettle is not in use.

f. Equip all kettles with a functioning temperature measuring device to ensure no heating in excess of 10 degrees C below the flash point.

g. Provide covers, lid, or top which are close fitting, constructed of minimum No.14 manufacturer's gauge steel, and can be gravity closed on all kettles.

h. Clean all roofing mops and rags free of excess asphalt and store safely away from all combustible materials. Store discarded roofing mops and rags in a non-combustible container and remove from site each day.

i. Position all pump lines handling hot asphalt securely and equip all pump lines with a shut-off valve on each with a coupler which may be opened when lines are full. Do not subject pump lines to pressures in excess of safe and recommended NRCA and ARMA working pressures. Station an operator near the equipment to cut off flow and care for other emergencies while conducting heating, pumping and application operations.

j. Asphalt bucket used by roofers or workers in similar trades must be constructed of minimum No. 24 gauge or heavier sheet steel and have a metal bail of no less than 6.35 mm diameter material. The bail is to be fastened to offset ears or equivalent which have been riveted, welded, or otherwise safely and securely attached to the bucket. Soldered bail sockets are prohibited. Position workers and other employees to avoid being struck by bucket or other roofing materials, which may accidentally fall while being hoisted, lowered, or used in the roofing operation. Provide safety barriers and caution signs at all skylights or other roof holes.

k. Do not use flammable liquids with a flash point below 37.78 degrees C (gasoline and similar products) for cleaning purposes.

Do not use solid fuel or Class I liquids as fuel for roofing asphalt kettles. Provide a minimum of one employee fully knowledgeable of kettle operations and hazards to maintain constant surveillance during kettle operation within a minimum distance of 7.62 m of the kettle.

Check all fire extinguishers prior to commencement of work, and upon completion of the day's work, to ensure fullness and operability.

Project supervisor must make daily inspections with the facility manager of all conditions and operations which could present hazards during [hot-mopped] applications and issue directives to address all such concerns and items of the work and existing conditions.

Identify and protect all combustible roof components, possible fire traps, and hidden hazards. Seal off voids or openings in the substrate with
non-combustible materials prior to installing [hot-mopped applied] materials in the area. Install protective fire retardant blankets and shields at building walls, eaves, parapets and equipments curbs constructed of combustible materials within 0.9144 meter radius of the area of [torch work][hot-mopped kettle] prior to commencement of the work.

When working around intakes and openings, temporarily disconnect and block to prevent [fumes from kettle] from being drawn into the opening. [Provide non-combustible shielding or flame guard protection where gaps or voids occur in the construction in area of torch work.]

1.7.2 Fire Watch

All personnel on the roof during [hot-mopped application] must be properly trained to use a fire extinguisher. Provide a fire watch for a minimum of [30 minutes after completion of hot-mopped kettle operations] at the end of each work shift. Maintain the fire watch for additional time required to ensure no potential ignition conditions exist. [Utilize heat sensing meters to scan for hot spots in the work.]

Do not leave the rooftop unattended during breaks in work during a work shift. Walk and scan all areas of application checking for hot spots, fumes, or smoldering, especially at wall and curb areas, prior to departure at the end of each work shift. Ensure any and all suspect conditions are eliminated prior to leaving the site each work shift.

1.7.3 Wind Conditions

Use side shields with all torching operations when winds are occurring to prevent flame distortion of end burners. Use torch machine equipment with bottom shield plate to prevent flame spread on to roof deck and substrate. When high wind gusts are present, notify the safety officer and cease all use of torching equipment until wind conditions lower and authorization from the safety officer to proceed is received.

1.8 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counter flashing and are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. [Apply roofing immediately following application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.]

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years.

1.9.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing,
insulation, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

c. Upon completion of installation, and acceptance by the [Contracting Officer], [Architect], [ Construction Manager] and Roofing System Engineer of Record, the manufacturer must supply the appropriate warranty to the Owner.

d. Installer must submit a minimum two year warranty to the membrane manufacturer from the date of acceptance, with a copy to the [Contracting Officer], [Architect], [Construction Manager] and Roofing System Engineer of Record.

1.9.2 Roofing System Installer Warranty

The roof system installer must warrant for a period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.9.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.10 CONFORMANCE AND COMPATIBILITY

Provide the entire roofing and flashing system in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with MLIT SS Chapter 9, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the Contracting Officer for approval.
prior to installation.

1.11 ELIMINATION, PREVENTION OF FALL HAZARDS

1.11.1 Fall Protection

PART 2 PRODUCTS

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

2.1.1 Energy [and Cool Roof] Performance

Install a roof system that meets an overall performance as specified on the drawings or by insulation specified in other sections. [Provide emittance and reflectance percentages, solar reflectance index values, [and] slopes [____], to meet sustainable third party certification requirements for Heat Island Reduction.]

2.2 MODIFIED BITUMEN SHEETS AND FIBERGLASS FELT MATERIALS

Furnish a combination of specified materials that comprise the modified bitumen manufacturer's standard system of the number and type of plies specified. Provide materials suitable for the service and climatic conditions of the installation. Modified bitumen sheets must be watertight and visually free of pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Polymer modifier must comply with MLIT SS Chapter 9 and be uniformly dispersed throughout the sheet. Edges of sheet must be straight and flat.

[a. Venting Base Sheet: [Without][With] perforations and as approved by the modified bitumen roof membrane manufacturer.

[b. Fiberglass Felt Base Sheet: JIS A 6022 or JIS A 6012, and as approved by the modified bitumen roof membrane manufacturer.

[c. SBS Base Sheet: Minimum 2.0 mm thick, and as approved by the roof membrane manufacturer.

[d. SBS Interply Sheet: Minimum 2.0 mm thick, and as approved by the roof membrane manufacturer.

[e. SBS Cap Sheet: Minimum 3.7 mm [____] thick, and as required to provide specified fire safety rating.

[f. APP Base Sheet: Minimum 3.5 mm thick, and as approved by the roof membrane manufacturer.

[g. APP Cap Sheet: Minimum 4.0 mm thick, and as approved by the roof membrane manufacturer.
2.3 BASE FLASHING MEMBRANE

Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the roof membrane specified and as recommended in membrane manufacturer's published literature. Provide flashing membranes that meet or exceed the properties of the material standards specified for the modified bitumen [base][, interply] and cap sheet, except that flashing membrane thickness must be as recommended by the membrane manufacturer.[ Provide metal clad flashing membrane that complies with MLIT SS Chapter 9].

2.4 ASPHALT

JIS A 6005 / JIS A 6013, in accordance with modified bitumen membrane manufacturer requirements and compatible with the slope conditions of the installation.

2.5 COLD-APPLIED MEMBRANE ADHESIVE

Membrane manufacturer's recommended [low volatile organic compound (VOC)] cold process adhesive for application of the membrane plies.

2.6 MEMBRANE SURFACING

Provide modified bitumen roof membrane cap sheet with factory-applied granule surfacing of [light][_____] color [as selected from membrane manufacturer's standard colors].[ Provide modified bitumen membrane manufacturer's recommended field-applied protective coating of [white][light gray][_____] color.][ Light colored, opaque water-worn gravel aggregate surfacing material as recommended by the membrane manufacturer and approved by the Contracting Officer[, and applied in flood coat of hot asphalt].]

2.7 PRIMER

Primer compatible with the application and as approved in writing by the modified bitumen membrane manufacturer.

2.8 MODIFIED BITUMEN ROOF CEMENT

Compatible with the modified bitumen roof membrane and as recommended by the modified bitumen membrane manufacturer.

2.9 CANT AND TAPERED EDGE STRIPS

Provide standard cants and tapered edge strips of [the same material as the roof insulation] treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Cant strips must be minimum [ 38 mm thick and provide for minimum 125 mm face and 85 mm vertical height when installed at 45 degree face angle][ 100 mm vertical height with 45 degree cant angle], except where clearance restricts height to lesser dimension. Taper edge strips at a rate of 25 mm to 38 mm per 300 mm to a minimum of 3 mm of thickness. Provide kiln-dried preservative-treated wood cants, in compliance with requirements of Section 06 10 00 ROUGH CARPENTRY at base of wood nailers set on edge and wood curbing and where otherwise indicated.
2.10 FASTENERS AND PLATES

Provide coated, corrosion-resistant fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470 and FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. For fastening of membrane or felts to wood materials, provide fasteners driven through 25 mm diameter metal discs, or one piece composite fasteners with heads not less than 25 mm in diameter or 25 mm square with rounded or 45 degree tapered corners.

2.10.1 Masonry or Concrete Walls and Vertical Surfaces

Use hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 25 mm long for securing felts, modified bitumen sheets, metal items, and accessories to masonry or concrete walls and vertical surfaces. Use power-driven fasteners only when approved in writing by the Contracting Officer.

2.10.2 Metal Plates

Provide flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; not less than 50 mm in diameter. Form discs to prevent dishing or cupping.

2.11 PRE-MANUFACTURED ACCESSORIES

Pre-manufactured accessories must be manufacturer's standard for intended purpose, compliant with applicable specification section, compatible with the membrane roof system and approved for use by the modified bitumen membrane manufacturer.

2.11.1 Pre-fabricated Curbs

Provide [_____] gauge [G90 galvanized][AZ55 galvalume][_____] curbs with minimum 100 mm flange for attachment to roof nailers. Curbs must be minimum height of 250 mm above the finished roof membrane surface.

2.11.2 Elevated Metal [Walkways] [and] [Platforms]

As specified in Section[ 05 50 13 MISCELLANEOUS METAL FABRICATIONS][ 05 51 33 METAL LADDERS][ 05 52 00 METAL RAILINGS][ 05 51 00 METAL STAIRS].

2.12 WALKPADS

Provide roof walkpads that are polyester reinforced, granule-surfaced modified bitumen membrane material, minimum [_____] [5 mm] thick, compatible with the modified bitumen sheet roofing and as recommended by the modified bitumen sheet roofing manufacturer. Panels must not exceed 1.219 meters in length. Other walkpad materials require approval of the Contracting Officer prior to installation.

2.13 PAVER BLOCKS

Precast concrete, minimum 38 mm thick, minimum 450 mm square for walkways and minimum 150 mm by 300 mm for use in supporting surface bearing components but extending not less than 50 mm beyond all sides of surface bearing bases. Install walkpad material under all paver blocks.
2.14 ROOF INSULATION BELOW MODIFIED BITUMEN MEMBRANE SYSTEM

Provide insulation compatible with the roof membrane, approved by the membrane manufacturer and meeting all the requirements of JIS A 9521 as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.15 MEMBRANE LINER

Provide self-adhering modified bitumen underlayment or other waterproof membrane liner material as approved by the Contracting Officer.

2.16 TOP COATING

Provide a top coating product that is complied with Energy Efficiency Standards/Labeling System based on Article 36 of the Act and is produced and compatible with the roof material of this specification. Provide data identifying Energy Efficiency Standard label for top coating product. Install to the manufacturer's written installation methods. Provide written confirmation that installation of a top coat will not modify or void the required roof warranty.

PART 3  EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Do not install items that show visual evidence of biological growth.

b. [Drains,] [curbs,] [cants,] [control joints,] [expansion joints,] [perimeter walls,] [roof penetrating components,] [and] [equipment supports] are in place.

c. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.

d. The plane of the substrate does not vary more than 6.35 mm within an area 3.048 by 3.048 meters when checked with a 3.048 meter straight edge placed anywhere on the substrate.

e. Substrate is sloped as indicated to provide positive drainage.

f. Walls and vertical surfaces are constructed to receive counter flashing, and will permit mechanical fastening of the base flashing materials.

g. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 200 mm above finished roofing surface.

h. Protect all combustible materials and surfaces which may contain concealed combustible or flammable materials. All fire extinguishing equipment has been placed as specified.

i. Verify all Fire Watch personnel assignments.
j. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures.[ Embedded nailers are flush with deck surfaces.][ Surface-applied nailers are the same thickness as the roof insulation.]

k. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than 88.9 mm.

l. Venting is provided in accordance with the following:
   (1) Edge Venting: Perimeter nailers are kerfed across the width of the nailers to permit escape of gaseous pressure at roof edges.
   (2) Underside Venting: Vent openings are provided in steel form decking for cast-in-place concrete substrate.

m. Exposed nail heads in wood substrates are properly set. Warped and split boards have been replaced. There are no cracks or end joints 6.35 mm in width or greater. Knot holes are covered with sheet metal and nailed in place. [Wood] decks are covered with rosin paper or unsaturated felt prior to base sheet or roof membrane application.[ Joints in plywood substrates are taped or otherwise sealed to prevent air leakage from the underside.]

n. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 6.35 mm in width. Insulation is being roofed over on the same day the insulation is installed.

o. Cast-in-place substrates have been allowed to cure and the surface dryness requirements specified under paragraph FIELD QUALITY CONTROL have been met.

p. Joints between precast concrete deck units are grouted, leveled, and stripped in with felt or bituminous stripping membrane set in bituminous cement prior to applying other roofing materials over the area.

q. Roof deck and framing are sloped as indicated to provide positive drainage.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists, tankers, and kettles prior to starting the work. Lap protective coverings not less than 15.24 cm, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.2.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped.
application of the roofing membrane.

][3.2.2 Equipment

3.2.2.1 Mechanical Application Devices

Mount mechanical application devices on pneumatic-tired wheels. Use devices designed and maintained to operate without damaging the insulation, roofing membrane, or structural components.

3.2.2.2 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

][3.2.3 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Utilize kettles with visible working thermometer and thermostatic controls set to the temperature limits specified herein. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus one degree C, to check temperatures of the asphalt frequently. When temperatures exceed maximums specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

3.2.3.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt between 260 and 274 degrees C for longer than four consecutive hours. Do not heat asphalt to the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 14 degrees C of the equiviscous temperature (EVT) but not less than 204 degrees C. Before heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt used.

][3.2.4 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 3 liters per 10 sq. meters or as recommended by modified bitumen sheet manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane applications.

3.2.4.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive membrane materials uniformly with primer.
3.2.4.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roof system prior to setting in bituminous materials or stripping into roofing system.

3.2.5 Membrane Preparation

Unroll modified bitumen membrane materials and allow to relax a minimum of 30 minutes prior to installation. In cold weather, adhere to membrane manufacturer's additional recommendations for pre-installation membrane handling and preparation. Inspect for damage, pinholes, particles of foreign matter, non-dispersed raw material, factory splices, or other conditions that might affect serviceability. Edges of seams must be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles. Discard damaged or defective materials.

3.2.6 Substrate Preparation

Apply membrane to clean, dry surfaces only. Do not apply membrane to surfaces that have been wet by rain or frozen precipitation within the previous 12 hours. Provide cleaning and artificial drying with heated blowers or torches as necessary to ensure clean, dry surface prior to membrane application.

3.3 APPLICATION

Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer. Keep roofing materials dry before and during application. Complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperatures for asphalt. [Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.]

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited unless otherwise approved by the Contracting Officer and supported by the membrane manufacturer's written application instructions. If cap sheet installation is delayed, thoroughly clean the applied membrane material surface and dry immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the Contracting Officer prior to cap sheet installation.

3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing [cooling towers,] [antennas,] [pipes,] [ducts,] [____,] is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

[3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.
3.3.3 Application Method

3.3.3.1 Hot Asphalt Application of Modified Bitumen Membrane

Apply membrane immediately following application of hot asphalt. Apply hot asphalt within 1.829 m of roll. Do not work ahead with asphalt. Asphalt must be completely fluid, with mop temperatures within the asphalt's EVT range, but not less than 204.4 degrees C, at the instant membrane comes into contact with asphalt. Apply bitumen between layers to provide full, continuous, uniform coverage and complete contact of hot asphalt with the sheet above and below. Embed sheets in asphalt. As sheets are being rolled into hot asphalt, immediately and thoroughly apply uniform positive pressure by squeegee, roll, or broom to ensure full adhesion and lap seal, eliminate trapped air and to provide tight, smooth laminations. Avoid excessive extrusion of asphalt at lap areas. Control asphalt bleed out to approximately 25.4 mm maximum.

3.3.3.2 Torch Applied [Heat Welded] Modified Bitumen Membrane [Flashing]

[Base flashing membrane may be torch applied.] Ensure substrate membrane surfaces are warmed either naturally or by torch during the installation. Apply heat evenly to underside of roll membrane being installed and exposed side lap area of previously installed sheet. Provide for slight, uniform flow of bitumen in front of roll and full width of roll as the material is being rolled or set into place. Apply uniform positive pressure to ensure membrane is fully adhered and all laps are sealed. Prior to forming lap over granulated surfaces, embed granules of the receiving sheet by heating and troweling-in the granules to form a uniform black compound surface. [Roll all lap areas with a weighted roller immediately after forming lap. Provide for visual bleed out of compound in lap areas.][ Avoid overheating the membrane or burning through to membrane reinforcement. Inspect and ensure all lap areas are fully sealed.

3.3.3.3 Cold Adhesive Applied Modified Bitumen Membrane

Apply cold adhesive with airless sprayer or 6.35 mm saw-toothed rubber squeegee to prepared surfaces in accordance with membrane manufacturer's application instructions. Fully cover substrate with adhesive. Roll or lay membrane in adhesive in accordance with manufacturer's recommendations and within the time limitations of adhesive application. Broom the membrane to ensure full contact with adhesive. Seal laps with adhesive or by heat fusing with torch or hot air welder as required by membrane manufacturer. Minimize traffic on installed membrane during the adhesive cure and set time.

3.3.4 Ventilating Base Sheets

Apply ventilating base sheets with 75 mm side laps and 150 mm end laps in accordance with manufacturer's printed application instructions for substrate [and wind uplift conditions ]specified. [Provide mechanical attachments as required for wind resistance specified and to include increased frequency of attachment at corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate.][ Top mop perforated sheet with a full, continuous mopping of hot asphalt.]

3.3.5 [Fiberglass Felt][Modified Bitumen] Base Sheet

[Fully adhere [spot adhere] base sheets in accordance with membrane manufacturer's printed instructions.] [Spot adhere base sheets with hot
asphalt applied in 300 mm diameter spots installed in two staggered rows, centered 300 mm in from edge of the base sheet.[ Apply cold adhesive with airless sprayer or a 6.35 mm saw-toothed rubber squeegee and at application rate recommended by the membrane manufacturer. Fully cover substrate with cold adhesive. Ensure laps areas of base sheet are fully sealed.] Roll and broom in the base sheet to ensure full contact with the [hot asphalt][adhesive] application.[ On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, mechanically fasten base sheet in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions.] Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 50 mm unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 150 mm and staggered a minimum of 900 mm. Apply sheets [at right angles to the roof slope so that the direction of water flow is over and not against the laps][parallel to the roof slope][so that plies of sheets extend from eave line on one side of the barrel-type roof and 450 mm over the center line of the crown of the roof. Apply sheets on the other side in the same manner, resulting in twice the normal amount of roofing sheets and asphalt at the crown]. Extend base sheets approximately 50 mm above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Application must be free of ridges, wrinkles, and buckles.

3.3.6 Modified Bitumen Membrane Application

Ensure proper sheet alignment prior to installation. [Apply membrane layers perpendicular to slope of roof in shingle fashion to shed water, including application on areas of tapered insulation that change slope direction.][Apply membrane layers parallel to slope of roof.] Bucking or backwater laps are prohibited. Fully adhere membrane sheets to underlying substrate materials. Provide minimum 75 mm side laps and minimum 150 mm end laps and as otherwise required by membrane manufacturer. Stagger end laps minimum 900 mm. Offset side laps between membrane layers a minimum of 300 mm. Offset end laps between membrane layers a minimum of 900 mm. Install all membrane layers the same workday, unless supported otherwise by roof membrane manufacturer application instructions and approved by the Contracting Officer. Provide tight smooth laminations of each membrane layer without wrinkles, ridges, buckles, kinks, fishmouths, or voids. Ensure full membrane adhesion and full lap seals. Rework to seal any open laps prior to application of subsequent membrane layers. The completed membrane application must be free of surface abrasions, air pockets, blisters, ridges, wrinkles, buckles, kinks, fishmouths, voids, or open seams.

3.3.6.1 Cap Sheet Installation

Underlying applied membrane must be inspected and repaired free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Do not apply cap sheet if rain or frozen precipitation has occurred within the previous 24 hours. Align cap membrane and apply by the specified method with the proper side and end lap widths. [Set cap sheet in hot asphalt or torch apply as recommended by the modified bitumen
membrane manufacturer. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. [Apply matching granules in any areas of [bitumen][adhesive] bleed out while the [asphalt is still hot][adhesive is still tacky].] Minimize traffic on newly installed cap sheet membrane.

3.3.6.2 Backnailing of Cap Sheet

Unless otherwise recommended by the modified bitumen membrane manufacturer and approved by the Contracting Officer, provide minimum 85 mm wide nailing strips matching insulation thickness and applied perpendicular to roof slope for backnailing of roof membrane. Space nailing strips as recommended by the membrane manufacturer, but not exceeding 5 m on center unless approved otherwise by the Contracting Officer. Coordinate the nailer installation with insulation requirements. Install the modified bitumen cap sheet to provide for end laps at nailer locations. Nail the modified bitumen cap sheet at the end lap area across the width of the sheet. Nail within 25 mm of each edge of the sheet and at 200 mm to 215 mm on center across the width of the sheet in a staggered fashion. Nails must have 25 mm diameter metal cap or be nailed through 25 mm diameter caps. Cover nails by overlapping adjacent upslope sheet at the end lap area.

3.3.7 Membrane Flashing

Apply two-ply modified bitumen strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Apply membrane flashing in accordance with the roof membrane manufacturers printed instructions and as specified. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of modified bituminous base flashing 150 mm on center through minimum 25 mm diameter tin caps with fasteners of sufficient length to embed minimum 25 mm into attachment substrate. [Apply matching granules in any areas of [asphalt][adhesive] bleed out while the [asphalt is still hot][adhesive is still tacky].] Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components. Metal flashing is specified under Section 07 60 00 FLASHING AND SHEET METAL. Do not set metal flashing in hot asphalt.

3.3.7.1 Membrane Strip Flashing

Set primed flanges of metal flashing in full bed of modified bituminous cement material and securely fasten through to attachment substrate. Strip-in with membrane flashing so that strip extends not less than 101.6 mm beyond outer edge of flange. Where multiple membrane stripping plies are installed, extend each additional stripping ply minimum 101.6 mm beyond edge of previous ply.

3.3.7.2 Membrane Flashing at Roof Drain

Roof drains are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Flashing for roof drains, is specified in Section 07 60 00 FLASHING AND SHEET METAL. Extend membrane sheets to edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp membrane sheets and metal roof.
drain flashing and strip flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds. Trim stripping must be flush with inside of clamping ring.

3.3.7.3 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flash with modified bitumen membrane.

3.3.7.4 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Install set-on accessories to permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.7.5 Lightning Protection

Flash and attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.8 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the modified bitumen sheet roofing manufacturer's printed instructions. Provide minimum 150 mm separation between adjacent walkpads to accommodate drainage. Provide walkpad [or an additional layer of cap sheet] under precast concrete paver blocks to protect the roofing.

3.3.9 Elevated Metal [Walkways] [and] [Platforms]

Install over completed roof system in accordance with [Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS]. Provide for protection of roof membrane by placing walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

3.3.10 Paver Blocks

Install paver blocks where indicated and as necessary to support surface bearing items traversing the roof area. Set paver block on a layer of walkpad [or cap sheet] applied over the completed roof membrane.

3.3.11 Field Applied Surfacing

After completion of roof membrane and flashing installation, and correction of tears, gouges, and other deficiencies in the installed work, apply specified surfacing.

3.3.11.1 Aggregate

Uniformly flood coat the surface with hot asphalt at a rate of approximate 27.2 kg per square. While asphalt is still hot, apply gravel aggregate surfacing material at a rate of 181.4 kg per square or 136.1 kg per square for slag or other approved aggregate surfacing. Provide for full and
uniform coverage of the roof surface. Solidly adhere approximately 50 percent of the aggregate in the asphalt.

][3.3.11.2 Coating Application

Apply surface coating materials to membrane and flashing in accordance with coating material manufacturer's recommendations.

][3.3.12 Correction of Deficiencies

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.

3.3.13 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and perform corrective actions as directed by the Contracting Officer.

3.5 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system from water intrusion.

[3.5.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system in an effective manner. [Seal off flutes in metal decking along the cutoff edge.] Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

][3.5.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashing can be applied. Remove temporary flashing before applying permanent flashing.

3.5.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.6 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify the Contracting Officer one day before performing tests.
3.6.1 Test for Surface Dryness

Before application of membrane sheets and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to which membrane materials are to be applied, one pint of asphalt when heated in the range of 176 to 204 degrees C, must not foam upon contact.

b. Strippability: On cementitious substrate surfaces, after asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by the method above and found dry.

c. Prior to installing any roof system on a concrete deck, conduct a test using plastic sheet over concrete surface. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

3.6.2 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Materials comply with the specified requirements.

b. Materials are not installed in adverse weather conditions.

All materials are properly stored, handled and protected from moisture or other damages.

c. Equipment is in working order. Metering devices are accurate.

d. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

(1) Nailers and blocking are provided where and as needed.

Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

(2) The proper number, type, and spacing of fasteners are installed.

Membrane heating, hot mopping, or adhesive application is provided uniformly and as necessary to ensure full adhesion of roll materials. Asphalt is heated and applied within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

(3) Lap areas of all plies are completely sealed.
Membrane is fully adhered without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashing and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

[3.6.2.1 Manufacturer's Inspection]

Manufacturer's technical representative must visit the site a minimum of three [_____] times [once per week] during the installation for purposes of reviewing materials installation practices and adequacy of work in place. [ Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer.] After each inspection, submit a report, signed by the manufacturer's technical representative to the Contracting Officer within 3 working days. Note in the report overall quality of work, deficiencies and any other concerns, and recommended corrective action.

[3.6.3 Samples of Roofing]

Take samples sized 100 mm by 1015 mm cut across width of modified bitumen sheets as directed by the Contracting Officer. Cut samples will be examined by the Contracting Officer for specified number of plies, proper lap width, complete lap seal, full uniform adhesive compound application and adhesion, full bond between plies, harmful foreign materials, presence of moisture, and wet insulation. Where cuts are not retained by the Contracting Officer or disposed, set cut strip back in cut area in bed of modified bitumen cement. Repair area of cut with new minimum two-ply modified bitumen membrane patch.

3.6.4 Roof Drain Test

After completing roofing, but prior to Government acceptance, perform the following test for watertight integrity. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.7 INSTRUCTIONS TO [GOVERNMENT][CONTRACTOR] PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the modified bitumen membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane.
Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations.

3.8 INFORMATION CARD

For each roof, furnish a typewritten information card for facility Records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 1 mm thick aluminum card for exterior display. Card must be 215 mm by 275 mm minimum, identifying facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**JAPANESE INDUSTRIAL STANDARDS (JIS)**

- **JIS A 6021** (2011) Liquid-applied Compounds for Waterproofing Membrane Coatings of Buildings
- **JIS G 3302** (2019) Hot Dip Zinc Coated Steel Sheet and Strip
- **JIS H 3100** (2018) Copper and Copper Alloy Sheets, Plates and Strips
- **JIS G 4305** (2015) Cold-Rolled Stainless Steel Plate, Sheet and Strip (Amendment 1)
- **JIS H 4000** (2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)
- **JIS K 2208** (2009) Asphalt Emulsion
- **JIS K 5602** (2008) Determination of Reflectance of Solar Radiation by Paint Film
- **JIS K 6720** (2008) Plastics-Vinyl Chloride Homopolymers and Copolymers (PVC)
- **JIS Z 3282** (2017) Solder-Chemical Composition and Shape
- **JIS Z 3604** (2016) Inert Gas Arc Welding Standard for Aluminum

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other
operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Exposed Sheet Metal Coverings; G[, [_____]]
Gutters; G[, [_____]]
Downspouts; G[, [_____]]
Expansion Joints; G[, [_____]]
Gravel Stops and fascia; G[, [_____]]
Splash Pans; G[, [_____]]
Flashing for Roof Drains; G[, [_____]]
Base Flashing; G[, [_____]]
Counterflashing; G[, [_____]]
Flashing at Roof Penetrations and Equipment Supports; G[, [_____]]
Scuppers; G[, [_____]]
Copings; G[, [_____]]
Drip Edges; G[, [_____]]
Conductor Heads; G[, [_____]]
Open Valley Flashing; G[, [_____]]
Eave Flashing; G[, [_____]]

SD-08 Manufacturer's Instructions

Instructions for Installation; G[, [_____]]
Quality Control Plan; G[, [_____]]

SD-10 Operation and Maintenance Data

Cleaning and Maintenance; G[, [_____]]
1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

Do not use lead, lead-coated metal, or galvanized steel. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper, and that contact between dissimilar metals must be avoided.

Furnish sheet metal items in 2400 to 3000 mm lengths. Single pieces less than 2400 mm long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 300 mm legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascia;
cap, valley, steeped, base, and eave flashings and related accessories.

2.2.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.2.3 Copper, Sheet and Strip

Provide in accordance with JIS H 3100, cold-rolled temper (standard).

2.2.4 Lead Sheet

Provide in a minimum weight of 19.6 kilograms per square meter.

2.2.5 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with JIS G 3302.

2.2.6 Zinc Sheet and Strip

Provide a minimum of 0.61 mm thick.

2.2.7 Stainless Steel

Provide in accordance with JIS G 4305, SUS302, 304 or SUS304, 2D Finish, fully annealed, dead-soft temper.

2.2.8 Terne-Coated Steel

Provide a minimum of 350 by 500 mm with minimum of 18 kilogram coating per double base box.

2.2.9 Aluminum Alloy Sheet and Plate

Provide in accordance with JIS H 4000 [anodized [clear] [color [_____] [_____]] form alloy, and temper appropriate for use. Provide material not less than [0.813 mm] [1.651 mm] in thickness.

2.2.9.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on [one side] [both sides] unless otherwise indicated.

a. Gutters, downspouts, and hangers
b. Gravel stops and fascia
c. Flashing

2.2.10 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied color coating of polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.020 to 0.033 mm. Color to be selected from [manufacturer's full range of "cool roof" color choices][manufacturer's standard range of color...
choices][manufacturer's full range of color choices][as indicated on the Drawings]. Field applications of color coatings are prohibited and will be rejected.

2.2.11 Cool Roof Finishes

Provide cool roof finish coatings and colors in accordance with one of the following methods of analysis:

2.2.11.1 JIS K 5602 and JIS K 5675

Provide roof finishes having minimum initial solar reflectance of [40][50] when tested in accordance with JIS K 5602 and JIS K 5675.

2.2.12 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

JIS H 4040.

2.2.13 Solder

Provide in accordance with JIS Z 3282, 95-5 tin-antimony.

2.2.14 Reglets

2.2.14.1 Polyvinyl Chloride Reglets

Provide in accordance with JIS K 6720, 1.9 mm minimum thickness.

2.2.14.2 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 6 mm and a depth of 30 mm, as approved.

2.2.14.2.1 Caulked Reglets

Provide with rounded edges, temporary reinforcing cores, and accessories as required for securing to adjacent construction. Provide built-up mitered corner pieces for inside and outside corners.

2.2.14.2.2 Friction Reglets

Provide with flashing receiving slots not less than 16 mm deep, 25 mm jointing tongues, and upper and lower anchoring flanges installed at 600 mm maximum snap-lock type receiver.

2.2.15 Scuppers

Line interiors of scupper openings with sheet metal. Provide a drip edge at bottom edges with returns of not less than 25 mm against the face of the outside wall at the top and sides. Provide the perimeter of the lining approximately 13 mm less than the perimeter of the scupper.

2.2.16 Conductor Heads

Provide conductor heads and screens in the same material as downspouts. Provide outlet tubes not less than 100 mm long.
2.2.17 Splash Pans

Provide splash pans where downspouts discharge onto roof surfaces and at locations indicated. Unless otherwise indicated, provide pans not less than 600 mm long by 450 mm wide with metal ribs across bottoms of pans. Provide sides of pans with vertical baffles not less than 25 mm high in the front, and 100 mm high in the back.

2.2.18 Copings

Unless otherwise indicated, provide copings in copper sheets, 2400 or 3000 mm long, joined by a 20 mm locked and soldered seam.

2.2.19 Bituminous Plastic Cement

Provide in accordance with JIS A 6021.

2.2.20 Roofing Felt

Provide in accordance with A6005 [Asphalt Felt] or [Asphalt Roofing].

2.2.21 Asphalt Primer

Provide in accordance with JIS K 2208.

2.2.22 Fasteners

Use the same metal as, or a metal compatible with the item fastened. Use stainless steel fasteners to fasten. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Metal Roofing

[3.1.1.1 Flat Copper,] [Zinc,] [Terne-coated Steel] Roofing

Before applying roofing, cover deck with rosin-sized roofing felt. Lap 50 mm at joints and secure in place with roofing nails. Using solder of equal parts tin and lead, solder slowly with well-heated irons to thoroughly heat sheet and completely sweat solder through full width of seam. Tin edges of copper to be soldered at least 20 mm before sheets are locked. Use stainless nails in terne-coated steel]; [in copper, use solid copper or bronze roofing nails]; [in zinc, use zinc-coated roofing nails.] Where roof decks abut vertical surfaces, turn metal roofing up vertical surfaces about 200 mm where practicable; where vertical surfaces are covered with applied materials, turn up roofing behind applied materials. Use standing-seam method for roofs having rise of more than one in four, and use flat-seam method when rise is one in four or less. Walking not permitted directly on metal roofs; provide approved walkways.

][3.1.1.2 Standing-seam Method

Make standing seams parallel with slope of roof. Fabricate sheets into long lengths at shop by locking short dimensions together and thoroughly soldering joints thus formed. In applying metal, turn up one edge of
course at each side seam at right angles 40 mm. Then install 50 by 75 mm cleats spaced 300 mm apart by fastening one end of each cleat to roof with two 25 mm long nails and folding roof end back over nail heads. Turn end adjoining turned-up side seam up over upstanding edge of course. Turn up adjoining edge of next course 45 mm and abutting upstanding edges locked, turned over, and flattened against one side of standing seam. Make standing seams straight, rounded neatly at the top edges, and stand about 25 mm above roof deck. All sheets must be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern.

3.1.1.3 Flat-seam Method

Lay metal so short dimension is parallel to gutter or eave lines and so water will flow over and not into seams. Make seams by turning edges of sheet 20 mm and lock and solder together. If sheets are laid one at a time, secure to roof deck with cleats, using three cleats to each sheet, two on long side and one on short side. Use cleats 50 mm wide, hooked over 20 mm upturned edges of sheets, and nail to roof deck with two 25 mm long nails. Turn back roof end of cleat over nail heads before next sheet is applied. If desired, sheets may be made into long lengths at shop by locking short dimensions together and soldering seams thus formed. Turn long lengths 20 mm, and secure each length to roof deck by cleats spaced 300 mm apart. Mallet and solder seams after pans are in place. All sheets to be same length, except as required to complete run or maintain pattern. Locate transverse joints of each panel half way between joints in adjacent sheets. Align joints of alternate sheets horizontally to produce uniform pattern.

3.1.2 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 13 mm hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction. Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.3 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 450 mm. Confine nailing of flashing to one edge only. Space nails evenly not over 75 mm on center and approximately 13 mm from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work.[ Secure flashing at one-half the normal interval to ensure a wind-resistant installation.]

3.1.4 Cleats

Provide cleats for sheet metal 450 mm and over in width. Space cleats evenly not over 300 mm on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 50 mm wide by 75 mm long and
of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. [Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. ]Pre-tin cleats for soldered seams.

3.1.5 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 1.0 mm or less in thickness.

3.1.6 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.6.1 Flat-lock Seams

Finish not less than 20 mm wide.

3.1.6.2 Lap Seams

Finish soldered seams not less than 25 mm wide. Overlap seams not soldered, not less than 75 mm.

3.1.6.3 Loose-Lock Expansion Seams

Not less than 75 mm wide; provide minimum 25 mm movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 3 mm thick bed.

3.1.6.4 Standing Seams

Not less than 25 mm high, double locked without solder.

3.1.6.5 Flat Seams

Make seams in the direction of the flow.

3.1.7 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 1.0 mm or less in thickness with specified sealants. Do not solder aluminum.

3.1.7.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pre-tinned. Seal the joints in aluminum sheets of 1.0 mm or less in thickness with specified sealants. Do not solder aluminum.

3.1.8 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 1.0 mm. Aluminum 1.0 mm
or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.8.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to JIS Z 3604.

3.1.8.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 300 mm maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 50 mm from the end of the overlapping sheet.

3.1.9 Protection from Contact with Dissimilar Materials

3.1.9.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.1.9.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint. Aluminum may be used over concrete construction, provided that required reglets are of stainless steel and aluminum surface in contact with concrete or masonry is coated with bituminous paint or zinc chromate primer.

3.1.9.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.9.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.10 Expansion and Contraction

Provide expansion and contraction joints at not more than 9750 mm intervals for aluminum and at not more than 12 meter intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 3600 mm apart.
3.1.11 Base Flashing

[Lay the base flashings with each course of the roof covering, shingle fashion, where practicable, where sloped roofs abut chimneys, curbs, walls, or other vertical surfaces. ]Extend up vertical surfaces of the flashing not less than 200 mm and not less than 100 mm under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 150 mm. Overlap the flashing strips [or shingles] with the previously laid flashing not less than 75 mm. Fasten the strips [or shingles] at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 150 mm on center with [large headed aluminum roofing nails] [hex headed, galvanized shielded screws] a minimum of 150 mm lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of [chimneys,] [curbs,] [and similar] vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 115 mm at the lower side of [dormer walls,] [chimneys,] [and similar] vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.12 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 230 to 250 mm above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 75 mm. Fold the exposed edges of counterflashings 13 mm. Where stepped counterflashings are required, they may be installed in short lengths a minimum [200 mm by 200 mm][200 mm by 250 mm] or may be of the preformed single piece type. Provide end laps in counterflashings not less than 75 mm and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 3000 mm. Form flashings to the required shapes before installation. Factory form corners not less than 300 mm from the angle. Secure the flashings in the reglets with lead wedges and space not more than 450 mm apart; on [chimneys and] [stair/elevator towers] short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashings with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 6 mm and extend not less than 50 mm into the walls. Install counterflashing to provide a spring action against base flashing.[ Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.]

3.1.13 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 6 mm and a minimum depth of 30 mm, when installed.

3.1.13.1 Caulked Reglets

Wedge flashing in reglets with lead wedges every 450 mm, caulked full and solid with an approved compound.
3.1.13.2 Friction Reglets

Install flashing snap lock receivers at 600 mm by 600 mm on center maximum. When flashing has been inserted the full depth of the slot, caulk the slot, lock [with wedges], and fill with sealant.

3.1.14 Polyvinyl Chloride Reglets for Temporary Construction

Rigid polyvinyl chloride reglets may be provided in lieu of metal reglets for temporary construction.

3.1.15 Gravel Stops and fascia

Prefabricate in the shapes and sizes indicated and in lengths not less than 2400 mm. Extend flange at least 100 mm onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascia after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascia on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 38 mm long spaced not more than 75 mm on center, in two staggered rows.

3.1.15.1 Edge Strip

Hook the lower edge of fascia at least 20 mm over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 150 mm maximum on center. Where fastening is made to concrete or masonry, use screws spaced 300 mm on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 2 mm thick compatible spacer or washers.

3.1.15.2 Joints

Leave open the section ends of gravel stops and fascia 6 mm and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 100 mm set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascia in accordance with the manufacturer's printed instructions and details.

3.1.16 Metal Drip Edges

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 75 mm and secure with compatible nails spaced not more than 250 mm on center along upper edge.

3.1.17 Gutters

The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 20
by 5 mm of material compatible with gutter. Fabricate gutters in sections not less than 2400 mm. Lap the sections a minimum of 25 mm in the direction of flow or provide with concealed splice plate 150 mm minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 750 mm on center as indicated by continuous cleats and or by cleats spaced not less than 900 mm apart. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from compatible metals.

3.1.18 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the [wood] [masonry] or [steel] substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 3000 mm lengths. Provide end joints to telescope not less than 13 mm and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than 25 mm away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 1500 mm on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.18.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.19 Flashing for Roof Drains

Provide a 750 mm square sheet indicated. Taper insulation to drain from 600 mm out. Set flashing on finished felts in a full bed of asphalt roof cement. Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing are free of wrinkles and folds.

3.1.20 Scuppers

Extend the scupper liner through and project outside of, the wall it penetrates to form a bottom drip edge against the face of the wall. Fold outside edges under 13 mm on all sides. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.21 Conductor Heads

Set the depth of the top opening equal to two-thirds of the width or the conductor head. Flat-lock solder seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 50 mm wider than
the scupper. Attach conductor heads to the wall with masonry fasteners. Securely fasten screens to heads.

3.1.22 Splash Pans

Install splash pans lapped with horizontal roof flanges not less than 100 mm wide to form a continuous surface. Bend the rear flange of the pan to contour of can't strip and extend up 150 mm under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.1.23 Open Valley Flashing

Provide valley flashing free of longitudinal seams, of width sufficient to extend not less than 150 mm under the roof covering on each side. Provide a 13 mm fold on each side of the valley flashing. Lap the sheets not less than 150 mm in the direction of flow and secure to roofing construction with cleats attached to the fold on each side. Nail the tops of sheets to roof sheathing. Space the cleats not more than 300 mm on center. Provide exposed flashing not less than 100 mm in width at the top and increase 25 mm in width for each additional 2400 mm in length. Where the slope of the valley is one in 2.67 or less, or the intersecting roofs are on different slopes, provide an inverted V-joint, 25 mm high, along the centerline of the valley; and extend the edge of the valley sheets 200 mm under the roof covering on each side.

Valley flashing for asphalt shingle roofs is specified in Section 07 31 13 ASPHALT SHINGLES.

3.1.24 Eave Flashing

One piece in width, applied in 2400 to 3000 mm lengths with expansion joints spaced as specified in paragraph EXPANSION AND CONTRACTION. Provide a 20 mm continuous fold in the upper edge of the sheet to engage cleats spaced not more than 250 mm on center. Locate the upper edge of flashing not less than 450 mm from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with 25 mm flat locked joints with cleats that are 250 mm on center.

3.1.25 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 375 by 455 mm. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.26 Expansion Joints

Provide expansion joints for roofs, walls, and floors as [specified] [indicated]. Provide [expansion joints in continuous sheet metal at [12 meter intervals for copper and stainless steel] [and at 9750 mm intervals for aluminum], [aluminum gravel stops and fascia which must have expansion joints at not more than 3600 mm spacing]. Provide evenly spaced joints. Provide an additional joint where the distance between the last expansion joint
joint and the end of the continuous run is more than half the required interval spacing]. Conform to the requirements of Table I.

3.1.26.1 Roof Expansion Joints

Consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Roofing Section. Provide counterflashing as specified in paragraph COUNTERFLASHING, except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than 25 mm for flashing on one side of the expansion joint and be less than the width of the expansion joint plus 25 mm for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. Joints are specified in Table II.

3.1.26.2 Floor and Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

3.1.27 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck. Goose-necks, rain hoods, power roof ventilators, and [_____] are specified in [_____].

3.1.28 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 75 mm on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 50 mm. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 100 mm roof flange in bituminous plastic cement and nailed 75 mm on center. Extend sleeve a minimum of 200 mm above the roof deck and lapped a minimum of 75 mm by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.29 Stepped Flashing

Provide stepped flashing where sloping roofs surfaced with shingles abut vertical surfaces. Place separate pieces of base flashing in alternate shingle courses.

3.1.30 Copings

Provide coping with locked and soldered seam. Terminate outer edges in edge strips. Install with sealed [lap joints][cover plate joints][standing seam joints] as indicated.
3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint sheet metal for separation of dissimilar materials.

[3.2.1 Aluminum Surfaces]

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.
<table>
<thead>
<tr>
<th>Sheet Metal Items</th>
<th>[Copper kilograms per square meter]</th>
<th>[Aluminum, mm]</th>
<th>[Stainless Steel, mm]</th>
<th>[Terne-Coated Stainless Steel, mm]</th>
<th>[Zinc-Coated Stainless Steel, mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Building Expansion Joints]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Cover]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>[Waterstop-bellows or flanged, U-type.]</td>
<td>4.9</td>
<td>-</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Covering on minor flat, pitched or curved surfaces]</td>
<td>6.125</td>
<td>1.02</td>
<td>0.46</td>
<td>0.46</td>
<td>-</td>
</tr>
<tr>
<td>[Downspouts and leaders]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>[Downspout clips and anchors]</td>
<td>-</td>
<td>1.02 clip 3.175 anchor</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Downspout straps, 50 mm]</td>
<td>14.7 (a)</td>
<td>1.52</td>
<td>1.27</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Conductor heads]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Scupper lining]</td>
<td>6.125</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Strainers, wire diameter or gage]</td>
<td>4.0 gage 3.66 diameter</td>
<td>2.77 diameter</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Flashings:]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Base]</td>
<td>6.125</td>
<td>1.02</td>
<td>0.46</td>
<td>0.46</td>
<td>0.6</td>
</tr>
<tr>
<td>[Cap (Counter-flashing)]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>0.5</td>
</tr>
<tr>
<td>[Eave]</td>
<td>4.9</td>
<td>-</td>
<td>0.38</td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>[Spandrel beam]</td>
<td>3.1</td>
<td>-</td>
<td>0.25</td>
<td>0.25</td>
<td>-</td>
</tr>
<tr>
<td>[Bond barrier]</td>
<td>4.9</td>
<td>-</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Stepped]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Valley]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Roof drain]</td>
<td>4.9 (b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

<table>
<thead>
<tr>
<th>Sheet Metal Items</th>
<th>[Copper kilograms per square meter]</th>
<th>[Aluminum, mm]</th>
<th>[Stainless Steel, mm]</th>
<th>[Terne-Coated Stainless Steel, mm]</th>
<th>[Zinc-Coated Steel, mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>(d) Pipe vent sleeve</td>
<td>4.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Coping]</td>
<td>4.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Gravel stops and fascia:]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Extrusions]</td>
<td>-</td>
<td>1.91</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Sheets, corrugated]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>-</td>
</tr>
<tr>
<td>[Sheets, smooth]</td>
<td>6.125</td>
<td>1.27</td>
<td>0.46</td>
<td>0.46</td>
<td>0.6</td>
</tr>
<tr>
<td>[Edge strip]</td>
<td>7.35</td>
<td>1.27</td>
<td>0.635</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Gutters:]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Gutter section]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>[Continuous cleat]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>[Hangers, dimensions]</td>
<td>25 mm by 3 mm (a)</td>
<td>25 mm by 2 mm (c)</td>
<td>25 mm by 1 mm</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>[Joint Cover plates (See Table II)]</td>
<td>4.9</td>
<td>0.81</td>
<td>0.38</td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>[Reglets (c)]</td>
<td>3.1</td>
<td>-</td>
<td>0.25</td>
<td>0.25</td>
<td>-</td>
</tr>
<tr>
<td>[Splash pans]</td>
<td>4.9</td>
<td>1.02</td>
<td>0.46</td>
<td>0.46</td>
<td>-</td>
</tr>
</tbody>
</table>

(a) Brass.

(b) May be lead weighing 19.6 kilograms per square meter.

(c) May be polyvinyl chloride.

(d) 12.25 kilogram minimum lead sleeve with 100 mm flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.
<table>
<thead>
<tr>
<th>Item Designation</th>
<th>Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel</th>
<th>Aluminum</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint cap for building expansion seam, cleated joint at roof</td>
<td>30 mm single lock, standing seam, cleated</td>
<td>30 mm single lock, standing</td>
<td>--</td>
</tr>
<tr>
<td>Flashings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>25 mm 75 mm lap for expansion joint</td>
<td>25 mm flat locked, soldered; sealed; 75 mm lap for expansion joint</td>
<td>Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.</td>
</tr>
<tr>
<td>Cap-in reglet</td>
<td>75 mm lap</td>
<td>75 mm lap</td>
<td>Seal groove with joint sealing compound.</td>
</tr>
<tr>
<td>Reglets</td>
<td>Butt joint</td>
<td>--</td>
<td>Seal reglet groove with joint sealing compound.</td>
</tr>
<tr>
<td>Eave</td>
<td>25 mm flat locked, cleated. 25 mm loose locked, sealed expansion joint, cleated.</td>
<td>25 mm flat locked, locked, cleated 25 mm loose locked, sealed expansion joints, cleated</td>
<td>Same as base flashing.</td>
</tr>
<tr>
<td>Stepped</td>
<td>75 mm lap</td>
<td>75 mm lap</td>
<td>--</td>
</tr>
<tr>
<td>Valley</td>
<td>150 mm lap cleated</td>
<td>150 mm lap cleated</td>
<td>--</td>
</tr>
<tr>
<td>Edge strip</td>
<td>Butt</td>
<td>Butt</td>
<td>--</td>
</tr>
</tbody>
</table>

Gravel stops:
<table>
<thead>
<tr>
<th>Item Designation</th>
<th>Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel</th>
<th>Aluminum</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrusions</td>
<td>--</td>
<td>Butt with 13 mm space</td>
<td>Use sheet flashing beneath and a cover plate</td>
</tr>
<tr>
<td>Sheet, smooth</td>
<td>Butt with 6 mm space</td>
<td>Butt with 6 mm space</td>
<td>Use sheet flashing backup plate.</td>
</tr>
<tr>
<td>Sheet, corrugated</td>
<td>Butt with 6 mm space</td>
<td>Butt with 6 mm space</td>
<td>Use sheet flashing beneath and a cover plate or a combination unit</td>
</tr>
<tr>
<td>Gutters</td>
<td>40 mm lap, riveted and soldered</td>
<td>25 mm flat locked riveted and sealed</td>
<td>Aluminum producers recommended hard setting sealant for locked aluminum joints.</td>
</tr>
</tbody>
</table>

(a) Provide a 75 mm lap elastomeric flashing with manufacturer's recommended sealant.

(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.

} -- End of Section --
PART 1  GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 PRODUCT DATA
1.4 ENVIRONMENTAL CONDITIONS
1.5 DELIVERY AND STORAGE
1.6 QUALITY ASSURANCE
  1.6.1 Compatibility with Substrate
  1.6.2 Joint Tolerance
  1.6.3 Mock-Up
  1.6.4 Adhesion

PART 2  PRODUCTS

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  2.1.1 Interior Sealants
  2.1.2 Exterior Sealants
  2.1.3 Floor Joint Sealants
  2.1.4 Acoustical Sealants
  2.1.5 Preformed Sealants
    2.1.5.1 Tape
    2.1.5.2 Bead
    2.1.5.3 Foam Strip
  2.2 PRIMERS
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  3.2.1 Steel Surfaces
  3.2.2 Aluminum or Bronze Surfaces
  3.2.3 Concrete and Masonry Surfaces
  3.2.4 Wood Surfaces
  3.2.5 Removing Existing Hazardous Sealants
3.3 SEALANT PREPARATION
3.4 APPLICATION
  3.4.1 Joint Width-To-Depth Ratios
  3.4.2 Unacceptable Sealant Use
  3.4.3 Masking Tape
3.4.4 Backstops
3.4.5 Primer
3.4.6 Bond Breaker
3.4.7 Sealants

3.5 PROTECTION AND CLEANING
3.5.1 Protection
3.5.2 Final Cleaning

-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


ASTM C919  (2012; R 2017) Standard Practice for Use of Sealants in Acoustical Applications

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 5758  (2016) Sealants for Sealing and Glazing in Buildings

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM, GOVERNMENT OF JAPAN (MLIT)


1.2  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only.  When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.]  Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING.  Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

1.3  PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories.  Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.
1.4 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 4 and 32 degrees C.

1.5 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed shipping containers, with brand name, date of manufacture, [color,] and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subject to sustained temperatures exceeding 32 degrees C or lower than 4 degrees C. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

1.6 QUALITY ASSURANCE

1.6.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

1.6.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.6.3 Mock-Up

Provide a mock-up of each type of sealant using materials, colors, and techniques approved for use on the project. Approved mock-ups may be incorporated into the Work.

1.6.4 Adhesion

Provide in accordance with JIS A 5758.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant products that have been tested, found suitable, and documented as such by the manufacturer for the particular substrates to which they will be applied, and comply with MLIT SS Chapter 9.

[ In areas with ambient temperatures that exceed 43.33 degrees C, do not use polybutene, bituminous, acrylic-latex, polyvinyl acetate latex sealants, polychloroprene (neoprene), and polyurethane foams, and neoprene, and styrene butadiene rubber extruded seals and closure strips due to these materials having maximum recommended surface temperature ranges from 54.44 degrees C to 82.22 degrees C.

]2.1.1 Interior Sealants

Provide sealant products per JIS A 5758, used on the interior of the building (defined as inside of the weatherproofing system) meeting VOC content requirements to attain F4-Stars rating or VOC content requirements per JIS A 1901, and meet Japan Sealants Industry Association requirement.
Provide certification or validation of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following. Note, color "as selected" refers to manufacturer's full range of color options:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface mounted equipment and fixtures, and similar items.</td>
<td>[As selected] [Gray] [White] [_____]</td>
</tr>
<tr>
<td>b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.</td>
<td>[_____]</td>
</tr>
<tr>
<td>c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.</td>
<td>[_____]</td>
</tr>
<tr>
<td>d. Joints between edge members for acoustical tile and adjoining vertical surfaces.</td>
<td>[_____]</td>
</tr>
<tr>
<td>e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.</td>
<td>[_____]</td>
</tr>
<tr>
<td>f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where non-planar tile surfaces meet.</td>
<td>[_____]</td>
</tr>
<tr>
<td>g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.</td>
<td>[_____]</td>
</tr>
<tr>
<td>h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.</td>
<td>[_____]</td>
</tr>
<tr>
<td>i. [_____]</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

2.1.2 Exterior Sealants

For joints in vertical surfaces and horizontal surfaces, provide JIS A 5758. Provide location(s) and color(s) of sealant as follows. Note, color "as selected" refers to manufacturer's full range of color options:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.</td>
<td>[Match adjacent surface color] [As selected] [Gray] [White] [_____]</td>
</tr>
<tr>
<td>b. Joints between new and existing exterior masonry walls.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>
c. Masonry joints where shelf angles occur.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. Masonry joints where shelf angles occur.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>


d. Joints in wash surfaces of stonework.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. Joints in wash surfaces of stonework.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

e. Expansion and control joints.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>e. Expansion and control joints.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

g. Voids where items pass through exterior walls.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>g. Voids where items pass through exterior walls.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

i. Metal-to-metal joints where sealant is indicated or specified.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Metal-to-metal joints where sealant is indicated or specified.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

j. Joints between ends of gravel stops, fascia, copings, and adjacent walls.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>j. Joints between ends of gravel stops, fascia, copings, and adjacent walls.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

k.  

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>k.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

2.1.3 Floor Joint Sealants

Provide sealant products per JIS A 5758 used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements to attain F4-stars rating or VOC content requirements per JIS A 1901, and meet Japan Sealant Industry Association requirement. Provide location(s) and color(s) of sealant as follows. Note, color "as selected" refers to manufacturer's full range of color options:

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COLOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Seats of metal thresholds for exterior doors.</td>
<td>[As selected] [Gray] [White] [_____]</td>
</tr>
<tr>
<td>b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

2.1.4 Acoustical Sealants

[_____] Rubber or polymer based acoustical sealant in accordance to ASTM C919, to have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Provide non-staining acoustical sealant with a consistency of 250 to 310. Acoustical sealant must remain flexible and adhesive after 500 hours of accelerated weathering. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) to have low or no pollutant emissions.
2.1.5 Preformed Sealants

Provide preformed sealants of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealants capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34 to plus 71 degrees C, sealants must be non-bleeding and have no loss of adhesion.

2.1.5.1 Tape

[_____] Tape sealant: Provide cross section dimensions of [____].

2.1.5.2 Bead

[_____] Bead sealant: Provide cross section dimensions of [____].

2.1.5.3 Foam Strip

Provide [_____] foam strip of polyurethane foam with cross section dimensions of [____]. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed in accordance with manufacturer's printed instructions. Service temperature must be minus 40 to plus 135 degrees C. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed onto adjacent finishes. Saturate treated strips with butylene waterproofing or impregnate with asphalt.

2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum[___] or other types of absorptive materials as backstops.

2.4.1 Rubber

Provide in accordance per manufacturer requirement [round] [_____] cross section for [_____] cellular rubber sponge backing.

2.4.2 Silicone Rubber Base

Provide in accordance with JIS A 5758. Color [as selected from
manufacturer's full range of color choices] [____].

2.5 CAULKING

For interior use and only where there is little or no anticipated joint movement. Provide products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements to attain F4-Stars rating or VOC content requirements per JIS A 1901. Provide certification or validation of indoor air quality for interior caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. [Protect adjacent aluminum and bronze surfaces from solvents]. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken.

3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.
3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

3.2.4 Wood Surfaces

Ensure wood surfaces that will be in contact with sealants are free of splinters, sawdust and other loose particles.

3.2.5 Removing Existing Hazardous Sealants

For sealants applied prior to 1979, or that have been tested and found to contain polychlorinated biphenyls (PCBs), remove and dispose of these sealants in accordance with Section 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs).

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

<table>
<thead>
<tr>
<th>JOINT WIDTH</th>
<th>JOINT DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum</td>
</tr>
</tbody>
</table>

For metal, glass, or other nonporous surfaces:

- 6 mm (minimum)  6 mm  6 mm
- over 6 mm  1/2 of width  Equal to width

For wood, concrete, masonry, stone, or [______]:

- 6 mm (minimum)  6 mm  6 mm
- over 6 mm to 13 mm  6 mm  Equal to width
- over 13 mm to 25 mm  50 mm  16 mm
- Over 25 mm  prohibited

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.
3.4.2 Unacceptable Sealant Use

Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories, or to close gaps between walls, floors, roofs, windows, and doors, that exceed acceptable installation tolerances. Remove sealants that have been used in an unacceptable manner and correct building enclosure deficiencies to comply with contract documents requirements.

3.4.3 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant smears. Remove masking tape within 10 minutes of joint filling and tooling.

3.4.4 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

3.4.5 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

3.4.6 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

3.4.7 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.
3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's printed instructions. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding. Remove resulting debris.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

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STEEL DOORS AND FRAMES

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PART 1   GENERAL
1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 4702 (2015) Doorsets
JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 3313 Electrolytic Zinc-Coated Steel Sheet and Strip
JIS G 3317 (2019) Hot-Dip Zinc-5 Percent Aluminum Allot-Coated Steel Sheet and Strip

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM, GOVERNMENT OF JAPAN (MLIT)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105 (2016; TIA 16-1) Standard for Smoke Door Assemblies and Other Opening Protectives
NFPA 80 (2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G[, [_____]]
Frames; G[, [_____]]

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of Doors; G[, [_____]]
Schedule of Frames; G[, [_____]]

Submit door and frame locations.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. [Strap knock-down frames in bundles.] [Provide temporary steel spreaders securely fastened to the bottom of each welded frame.] Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

JIS A 4702, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Provide exterior doors with top edge closed flush and sealed to prevent water intrusion. Provide doors at 44.5 mm thick, unless otherwise indicated. Provide door material that uses a minimum of 25 percent recycled content. [Provide exterior glazing in accordance with project load resistance requirement.]

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Standard Duty Doors (Level 1)

35mm to 45 mm door thickness, 0.8mm door faces steel thickness, 1.0mm frames steel thickness [full flush] of size(s) and design(s) indicated and
core construction as required by the manufacturer. Provide door classification label per JIS A 4702.

2.1.1.2 Heavy Duty Doors (Level 2)

45 mm door thickness, 1.0mm door faces steel thickness, 1.3mm frames steel thickness [full flush] [seamless], with core construction as required by the manufacturer [for interior doors] [and ] [for exterior doors], of size(s) and design(s) indicated. [Where vertical stiffener cores are required, the space between the stiffeners must be filled with mineral board insulation.][ Provide door classification label per JIS A 4702.]

2.1.1.3 Extra Heavy Duty Doors (Level 3)

45 mm door thickness, 1.3mm door faces and frames steel thickness, [full flush] [seamless] [stile and rail] with core construction as required by the manufacturer [for interior doors] [and ] [for indicated exterior doors], of size(s) and design(s) indicated. [Where vertical stiffener cores are required, the space between the stiffeners must be filled with mineral board insulation.][ Provide door classification label per JIS A 4702.]

2.1.1.4 Maximum Duty Doors (Level 4)

45 mm door thickness, 1.7mm door faces and frames steel thickness, [full flush] [seamless] with core construction as required by the manufacturer [for interior doors] [and ] [for indicated exterior doors], of size(s) and design(s) indicated. [Where vertical stiffener cores are required, the space between the stiffeners must be filled with mineral board insulation.][ Provide door classification label per JIS A 4702.]

2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Provide standard steel doors in the door size(s), design(s), materials, construction, gages, and finish as specified for standard steel doors and complying with the requirements. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 1.5 mm thick.[ Close tops of exterior doors flush with an additional channel and seal to prevent water intrusion.] Prepare doors to receive hardware specified in Section 08 71 00 DOOR HARDWARE.[ Undercut doors where indicated.] Provide doors at 45 mm thick, unless otherwise indicated.

2.3 INSULATED STEEL DOOR SYSTEMS

[At the option of the Contractor, insulated steel doors and frames may be provided in lieu of Level 1 standard steel doors and frames. Provide insulated steel doors in the door size(s), design, and material as specified for standard steel doors. ]Provide insulated steel doors with a core of polyurethane foam; face sheets, edges, and frames of galvanized steel not lighter than 0.7 mm thick, 1.5 mm thick, and 1.5 mm respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Provide to doors and frames a phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Door shall meet JIS A 4702 and tested for 500,000 cycles. Prepare doors to receive specified hardware. Provide doors 44.5 mm thick.[ Provide insulated steel doors and frames [at entrances to dwelling units][where shown][______].]
[2.4] **SOUND RATED STEEL DOORS**

Provide sound rated doors with a Transmission Loss (TL) of [_____] as indicated on the drawings.

[2.5] **ACCESSORIES**

2.5.1 **Shelves for Dutch Doors**

Fabricate shelves of steel not lighter than 1.5 mm thick, [_____] mm wide of the size indicated. Provide brackets of stock type fabricated of the same metal used to fabricate shelves.

2.5.2 **Louvers**

2.5.2.1 **Interior Louvers**

Where indicated, provide louvers of stationary [sightproof][ and ] [lightproof] type[ where scheduled]. [Louvers for lightproof must shall not transmit light.] Detachable moldings on room or non-security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 1 mm thick steel and louver blades of a minimum 0.6 mm. [Louvers for lightproof doors must have minimum of 20 percent net-free opening.][Sightproof louvers to be inverted ["V" blade design with minimum 55] and ] [inverted ["Y"] blade design with minimum 40] percent net-free opening.]

2.5.2.2 **Exterior Louvers**

Provide louvers of the inverted ["Y"] ["V"] ["Z"] type with minimum of 30][55][35] percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. At louvers provide steel-framed [insect][bird] screens secured to room side and readily removable. Provide [aluminum wire cloth, 7 by 7 per 10 mm or 7 by 6 per 10 mm mesh, for insect screens][galvanized steel, 13 by 13 mm mesh hardware cloth, for bird screens]. Net-free louver area to be before screening.

2.5.3 **Astragals**

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors.[For interior pairs of [fire rated][ and ] [smoke control] doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies][ and ][NFPA 105 for smoke control assemblies].

2.5.4 **Moldings**

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Provide muntins that interlock at intersections and are fitted plus welded to stationary moldings.
2.6 INSULATION CORES

Provide insulating cores of the type specified, and provide an apparent U-factor per insulation requirements in accordance with JIS A4702, [H-____]

2.7 STANDARD STEEL FRAMES

Provide hardware reinforcing thickness per ANSI/SDI A250.8 requirement. Form frames to sizes and shapes indicated, with [welded corners][ or ][knock-down field-assembled corners]. Provide steel frames for doors, [transoms,] [sidelights,] [mullions,] [cased openings,][ and ][interior glazed panels,] unless otherwise indicated. Provide frame product that uses a minimum of 25 percent recycled content. Provide data indicating percentage of recycled content for steel frame product.

2.7.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of Welding Code per JIS Z 3420 and in accordance with the practice specified by the producer of the metal being welded.

2.7.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.7.3 Mullions and Transom Bars

Provide mullions and transom bars of closed or tubular construction with heads and jambs butt-welded together[ or knock-down for field assembly]. Bottom of door mullions must have adjustable floor anchors and spreader connections.

2.7.4 Stops and Beads

Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 300 to 400 mm on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.7.5 Terminated Stops

Where indicated, terminate interior door frame stops 150 mm above floor.[ Do not terminate stops of frames for [lightproof,] [soundproof,] [or lead-lined] doors.]

2.7.6 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.
2.7.7 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick.

2.7.7.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened [to wood studs with nails,] [to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding];

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with JIS A 4702; and

d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Provide size and type of strut anchors as recommended by the frame manufacturer.

2.7.7.2 Floor Anchors

Provide floor anchors drilled for 10 mm anchor bolts at bottom of each jamb member. [Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.]

2.8 FIRE [AND] [SMOKE] DOORS AND FRAMES

NFPA 80 [and] [NFPA 105] and this specification. The requirements of NFPA 80 [and] [NFPA 105] takes precedence over details indicated or specified.

2.8.1 Labels

Provide fire doors and frames bearing the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing must be in accordance with NFPA 252 or UL 10C. Provide labels that are metal with raised letters, bearing the name or file number of the door and frame manufacturer. Labels must be permanently affixed at the factory to frames and to the hinge edge of the door. Do not paint door and labels. Use of Japanese tested and labeled fire doors, up to 20 minutes, is permitted. NFPA 252 paragraph 6.2.2 requires hose stream test for fire rated doors greater than 20 minutes. Japanese manufactured fire rated doors are not subjected to hose stream tests and are not deemed equivalent to US products or requirements.
2.8.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.8.3 Astragal on Fire [and Smoke] Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements.[ On smoke control doors, conform to NFPA 105.]

2.9 WEATHERSTRIPPING

As specified in Section 08 71 00 DOOR HARDWARE.

2.9.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08 71 00 DOOR HARDWARE. Insert gasket in groove after frame is finish painted. Provide doors where air leakage of weatherstripped doors does not exceed [2.19 by 10-5] [5.48 by 10-5] cubic meters per second of air per square meter of door area when tested in accordance with JIS A 1516.

2.10 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in JIS A 4702. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of JIS A 4702. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of JIS A 4702, as applicable. Punch door frames [, with the exception of frames that will have weatherstripping [or] [lightproof] [or] [soundproof] gasketing,] to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.11 FINISHES

2.11.1 Factory-Primed Finish

Thoroughly clean all surfaces of doors and frames then chemically treat and factory prime with a rust inhibiting coating as specified in JIS A 4702.[ , or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.]

2.11.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate [exterior][interior][scheduled] doors and frames from hot dipped zinc coated steel, alloyed type, that complies with JIS G 3302 and JIS G 3317. The coating weight must meet or exceed the minimum requirements for coatings having zinc-5 percent. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in JIS A 4702.[ Provide for [exterior doors][ and ][interior
doors][door openings No. [_____]].

2.11.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with JIS G 3313, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in JIS A 4702.

2.11.4 Factory-Applied Enamel Finish

Provide coatings that meet test procedures and acceptance criteria in accordance with JIS A 4702. After factory priming, apply [one coat][two coats] of [low-gloss][medium-gloss] enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements must be in accordance with the coating manufacturer's recommendations. Provide finish coat color(s) [as indicated][_____] to match approved color sample(s).

2.12 FABRICATION AND WORKMANSHIP

Provide finished doors and frames that are strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Provide molded members that are clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints must be well formed and in true alignment. Conceal fastenings where practicable.[ Frames for use in solid plaster partitions must be welded construction.][ On wraparound frames for masonry partitions, provide a throat opening 3 mm larger than the actual masonry thickness.][ Design[ other] frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.]

2.12.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

2.13 PROVISIONS FOR GLAZING

Materials are specified in Section 08 81 00, GLAZING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with JIS A 4702 and MLIT SS Chapter 16. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. [Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing.][ Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.]
3.1.2 Doors

Hang doors in accordance with clearances specified in JIS A 4702 and MLIT SS Chapter 16. After erection and glazing, clean and adjust hardware.

3.1.3 Fire [and Smoke] Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)


INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 4702 (2015) Doorsets

JIS H 4000 (2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)

JIS H 4100 (2015) Aluminum and Aluminum Alloy Extrusions


JIS K 5906 (1998) Aluminum Pigments For Paints


MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM, GOVERNMENT OF JAPAN (MLIT)

MLIT SS Chapter 16 (2019) Building Construction Standard
1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural Calculations

Commentary: Add wind pressure requirements in accordance with ASCE 7.

1.2.1.1 Minimum Antiterrorism Performance

Provide doors meeting the minimum antiterrorism performance as specified in the paragraphs below.

Aluminum door, window frame and window wall shall be designed to support the wind pressures specified, but not less than the minimum section properties indicated. The anchorages shall be designed to support the wind load reactions calculated, but not less than the support loads indicated on the contract documents.

If the minimum section properties and anchorages were not indicated, one of the following methods can be used as noted in the following:

[a. Static Equivalent Load Design

1.2.2 Wind Borne Debris

Provide impact resistant door [_____] assemblies meeting the Windborne-Debris-Impact Resistant Performance requirements of JIS R 3109 as follows:

(1) Pass missile-impact tests when tested according to JIS R 3109 for missiles A and D in Table 2 or ISO 16932 (Missile C).

1.2.3 Air Infiltration

When tested in accordance with JIS A 1516, air infiltration per door leaf cannot exceed 2.83 by 10^-4 cms per square meter of fixed area at a test pressure of 0.30 kPa.

1.2.4 Water Penetration

When tested in accordance with JIS A 1517, there can be no water penetration at a pressure of 0.14 kPa of fixed area.

1.2.5 Thermal Transmittance, Solar Heat Gain, Visible Light Transmittance

1.2.5.1 U-Factor

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area with U-Factor [_____].

1.2.5.2 Solar Heat Gain Coefficient (SHGC)

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the National Fenestration Rating Council with a whole window SHGC of [_____].
1.2.5.3 Visible Light Transmittance (VLT)

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area with VLT [____].

[1.2.5.4 Doors with Less than 50 Percent Glazed Area]

For exterior aluminum entrances doors with less than 50 percent glazed area, the glazed area is considered the fenestration area with a whole window U-Factor, SHGC and VLT as required above.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   For Each Type of Door and Frame Assembly; G[, [_____]]

SD-04 Samples
   Finish Samples; G[, [_____]]

SD-05 Design Data
   Structural Calculations for Deflection; G[, [_____]]

SD-06 Test Reports
   Air Infiltration; G[, [_____]]
   Water Penetration; G[, [_____]]

SD-10 Operation and Maintenance Data
   Adjustments, Cleaning, and Maintenance; G[, [_____]]

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on non-absorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which caulking and glazing compounds must adhere.
1.5 QUALITY CONTROL

1.5.1 Shop Drawing

Indicate elevations and sections for each type of door and frame assembly. Show sizes and details of each assembly, frame construction, [subframe attachment], thickness and gages of metal, details of door and frame construction, proposed method(s) of anchorage, glazing details, provisions for an location of hardware, [mullion details], method and materials for flashing and weatherstripping, miscellaneous trim, installation details, and other related items necessary for a complete representation of all components. A qualified blast engineer must perform testing or calculations for door system design resistance to specified blast loads.

1.5.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.5.3 Operation and Maintenance Data

Submit detailed instructions for installation, adjustments, cleaning, and maintenance of each type of assembly indicated.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Provide swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members[, subframes][, transoms][, adjoining side lites], trim, and accessories.[ Coordinate side lites, window walls, adjacent curtainwall with Section 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS][ and Section 08 44 00 CURTAIN WALL AND GLAZED ASSEMBLIES.]

2.2 MATERIALS

2.2.1 Anchors

Stainless steel [or steel with hot-dipped galvanized finish].

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer, and per JIS A 4702.

2.2.3 Aluminum Alloy for Doors and Frames

JIS H 4040, Alloy 6063-T5 for extrusions. JIS H 4000, alloy and temper best suited for aluminum sheets and strips.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

JIS H 4100.
2.2.6 Aluminum Paint

Aluminum door manufacturer's standard aluminum paint.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 300 mm on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and minimum 45 mm thick. Minimum wall thickness, 3 mm, except beads and trim, 1.25 mm. Door sizes shown are nominal; include standard clearances as follows: 2.5 mm at hinge and lock stiles, 3 mm between meeting stiles, 3 mm at top rails, 5 mm between bottom and threshold, and 17 mm between bottom and floor. Provide bevel single-acting doors 2 or 3 mm at lock, hinge, and meeting stile edges. Provide double-acting doors rounded edges at hinge stile, lock stile, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Provide doors with narrow, medium, or wide stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 10 or 13 mm diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.2.2 Flush Doors

Use facing sheets with a vertical ribbed, an embossed, or a plain smooth surface. Use one of the following constructions:

a. A phenolic resin-impregnated kraft paper honeycomb core, surrounded at edges and around glass and louvered areas with extruded aluminum shapes. Provide cores with a minimum impregnation of 18 percent resin content. Provide sheet aluminum door facings minimum 0.8 mm thick laminated to a 2.5 mm thick tempered hardboard backing, with the backing bonded to the honeycomb core. Bond facing sheets to cores under heat and pressure with thermosetting adhesive and mechanically lock to extruded edge members.

b. A phenolic resin-impregnated kraft paper honeycomb core. Use aluminum facing sheets minimum 1.25 mm thick and form into two pans to eliminate seams on faces. Bond honeycomb core to face sheets using epoxy resin or contact cement-type adhesive.

c. A solid fibrous core, surrounded at edges and around glass and louvered areas and cross braced at intermediate points with extruded aluminum shapes. Use aluminum facing sheets of minimum 1.25 mm thickness. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
d. Form from extruded tubular stiles and rails mitered at corners, reinforce, and continuously weld at miters. Provide facing sheets of minimum 0.8 mm thick sheet aluminum internally reinforced with aluminum channels or Z-bars placed horizontally not more than 400 mm apart and extending the full width of panels. Fit spaces between reinforcing with sound-deadening insulation. Weld facing sheets to reinforcing bars or channels and to stiles and rails. Finish facing sheets flush with faces of stiles and rails.

e. Form from an internal grid composed of extruded aluminum tubular sections. Provide tubular sections at all sides and perimeter of louver and glass openings. Provide three extruded aluminum tubular sections at top and bottom of each door. Provide wall thickness of tubular sections minimum 2.25 mm except at lock rails which must be minimum 3 mm thick, hinge lock rails which must be minimum 3 mm thick, and hinge rail edges which must be minimum 5 mm thick. Fill spaces in door with mineral insulation. Provide facing sheets of aluminum minimum 2.25 mm thick.

f. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass openings. Provide wall sections of extruded aluminum members minimum 2.25 mm thick and reinforce for application of hardware. Cover framing members on both sides with aluminum facing sheets minimum 2 mm thick. Fill door panels with [172 kPa density polystyrene] [40 kg per cubic meter density, chlorofluorocarbon (CFC) free, foamed urethane] with a flame spread rating of no more than 25.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and must have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping must be replaceable without special tools, and adjustable at meeting rails of pairs of doors. During installation, verify doors swing freely and close positively. Refer to paragraph AIR INFILTRATION for air leakage requirements and testing.

2.3.5 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill.[ Where indicated, reinforce vertical Mullions with structural steel members of sufficient length to extend up to the overhead structural slab or framing and secure thereto.][ Reinforce and anchor freestanding door frames to floor construction as indicated on approved shop drawings and in accordance with manufacturer's recommendation.] Place anchors [as indicated][near top and bottom of each jamb and at intermediate points not more than 635 mm apart].
2.3.6 Provisions for Hardware

Coordinate with Section 08 71 00 DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws. (Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware.)

2.3.7 Provisions for Glazing

[Provide extruded aluminum snap-in glazing beads on interior side of doors.][Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors.][Provide glazing beads with vinyl insert glazing gaskets.][Design glazing beads to receive thickness indicated for each glazed assembly.] Coordinate requirements with Section 08 81 00 GLAZING.

2.3.8 Finishes

Provide exposed aluminum surfaces with [mill finish] [factory finish of anodic coating or organic coating].

2.3.8.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to JIS H 8602. Provide [as selected from manufacturer's [standard][complete] range of color options].

2.3.8.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide [a baked enamel finish in accordance with JIS K 5906 with total dry film thickness minimum 0.02 mm]. Finish color to be [_____] [as indicated] [as selected from manufacturer's [standard][complete] range of color options].

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors[, transoms][, adjoining side lites][, and][, adjoining window walls] per MLIT SS Chapter 16. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions and the approved shop drawings. Install anchorage that complies with applicable structural requirements. Anchor bottom of each frame to rough floor construction with 2.4 mm thick minimum stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Hang doors to produce clearances specified in paragraph ALUMINUM DOORS. After erection and glazing, adjust doors and hardware to operate properly.
3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

3.2.1.1 Protection

Provide one of the following systems to protect surfaces in contact with dissimilar metals:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply elastomeric sealant between aluminum and dissimilar metals in accordance with Section 07 92 00 JOINT SEALANTS.

c. Paint dissimilar metals with one coat of primer and one coat of aluminum paint.

d. Use a non-absorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting aluminum, paint the wood or other absorptive surface with two coats of aluminum paint and seal joints with elastomeric sealant.

3.3 SEALING AROUND ASSEMBLIES

Seal all penetrations of the air barrier by sealing around door openings as necessary to achieve compliance with air leakage requirements indicated in [the air barrier sections of the specifications][1, the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM][1, and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS]. Flash all doors with corrosion resistant flashing to prevent water intrusion.

3.4 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's written recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.
3.5 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

-- End of Section --
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SECTION 08 14 00

WOOD DOORS

08/16

PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E2226 (2015a; R 2019b) Standard Practice for Application of Hose Stream

FOREST STEWARDSHIP COUNCIL JAPAN (FSC)

FSC STD 01 001 (2015) Principles and Criteria for Forest Stewardship

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 8272 (1985) Doorsets - Air Permeability Test

ISO 10140 (2016) Acoustics - Laboratory Measurement of Sound Insulation of Building Elements

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS K 6903 (2008) Laminated Thermosetting High-Pressure Decorative Sheets

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

MLIT-SS Ch 16, Sec 7 (2019) Public Building Construction Standard Specification: Chapter 16, Section 7 Wood Door
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors; G[, [______]]

Submit drawings or catalog data showing each type of door unit [; include descriptive data of head and jamb weatherstripping with installation instructions]. Indicate within drawings and data the door types and construction, sizes, thickness, [methods of assembly,] [door louvers,] and [glazing,].

SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

Door Finish Colors

Submit a minimum of three color selection samples [, minimum 76
SD-11 Closeout Submittals

Warranty

1.3 CERTIFICATIONS

1.3.1 Certified Wood Grades

Provide certificates of grade from the grading agency on [acoustical doors], and [fire doors].

1.3.2 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, SGEC Certification Japan[, or other third party program certified by PEFC ST 2002:2013]. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third-party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

1.3.3 Indoor Air Quality Certification

1.3.3.1 Composite Wood, Wood Structural Panel and Agrifiber Products

For purposes of this specification, composite wood and agrifiber products include particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Provide products certified to meet F**** requirements of JIS A 1460.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity.[ Do not store in a building under construction until concrete, masonry work, and plaster are dry.] Replace defective or damaged doors with new ones.

1.5 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs [indicated] [specified] free of urea-formaldehyde resins. Provide products certified to meet F**** requirements of JIS A 1460.
2.1.1 Stile and Rail Doors

Stile and rail doors conforming to MLIT-SS Ch 16, Sec 7. Furnish laminate panels in not less than three ply thickness. Provide flat panels with a minimum finished panel thickness of [_____] mm and [_____] mm thickness for raised panels.[ Provide certified sustainably harvested stile and rail wood doors.]

2.1.2 Flush Doors

Conform to MLIT-SS Ch 16, Sec 7 for flush doors. Provide hollow core doors with lock blocks and 25 mm minimum thickness hinge stile. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. Provide mill option for stile edge of doors scheduled to be painted. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.[ Provide certified sustainably harvested flush wood doors.]

2.1.2.1 Interior Flush Doors

Provide [staved lumber] [particleboard] [agrifiber] [hollow] core, Type II flush doors conforming to MLIT-SS Ch 16, Sec 7 with faces of [sound grade hardwood or hardboard for painted finish] [premium] [good] grade [natural birch] [select [premium white] [red] birch] [[premium] [good] grade [red] [white] oak] [premium] [good] grade walnut] [plastic laminate]. [Hardwood veneers must be [[rotary cut] [plain sliced] [quarter sliced]] [[random] [slip] [book] matched]]. [Finish plastic laminate faced doors on both vertical edges with [wood] [laminated plastic] of color matching faces.] [Products must contain no added urea-formaldehyde resins.]

2.1.3 Bi-Fold Closet Doors

Provide [hardboard grade flush doors conforming to MLIT-SS Ch 16, Sec 7.] [paneled] [louvered] doors [premium or select] [standard] grade, conforming to MLIT-SS Ch 16, Sec 7 with [_____] mm thickness. Equip doors with the manufacturer's standard hardware, including tracks, hinges, guides, and pulls.

2.1.4 Sliding Closet Doors

Provide flush wood doors to conform to MLIT-SS Ch 16, Sec 7. Provide [paneled] [and] [louvered] doors to conform to MLIT-SS Ch 16, Sec 7 [premium or select] [standard] grade with [_____] mm thickness. Equip doors with the manufacturer's standard hardware.

2.1.5 Acoustical Doors

MLIT-SS Ch 16, Sec 7, solid core, constructed to provide Weighted Sound Reduction Index (Rw) rating of [35] [_____] when tested in accordance with JIS A 1416 or ISO 10140.

2.1.6 [Composite-Type] Fire Doors

Provide doors specified or indicated to have a fire resistance rating conforming to the requirements of UL 10B, ASTM E2226, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.
2.1.7 Prehung Doors

Frames for prehung interior doors to be for [painted] [clear] finish, with [3 piece adjustable jamb units] [3 piece adjustable jamb units with pins]. Provide doors complete with frame, hinges, and prepared to receive finish hardware.

2.2 ACCESSORIES

2.2.1 Door Louvers

Fabricate from wood and of sizes indicated. Provide louvers with a minimum of 35 percent free air. Equip louvers with [slat] [sightproof inverted vee slat] type. [Block hollow core doors to provide solid anchorage for the louvers.] Mount louvers in the door with [flush wood moldings.] [wood lip moldings.]

2.2.2 Door Light Openings

Provide glazed openings with the manufacturer's standard wood moldings. [Provide moldings for doors to receive natural finish of the same wood species and color as the wood face veneers.] Provide moldings on the exterior doors with sloped surfaces. [Lip type moldings for flush doors.]

2.2.3 Weatherstripping

Provide weatherstripping that is a standard cataloged product of a manufacturer regularly engaged in the manufacture of this specialized item. Provide weatherstripping [tempered spring bronze] [or] [looped neoprene or vinyl held in an extruded non-ferrous metal housing]. Install [bronze weatherstripping with a minimum thickness of 0.23 mm for sills, and a minimum thickness of 0.16 mm elsewhere.] Air leakage of weatherstripped doors not to exceed [0.0025] [0.0031] cubic meter per second of air per square meter of door area when tested in accordance with JIS A 1516 or ISO 8272.

2.2.4 Additional Hardware Reinforcement

Provide the minimum lock blocks to secure the specified hardware. The measurement of top, bottom, and intermediate rail blocks is a minimum 125 mm by full core width. Comply with the manufacturer’s labeling requirements for reinforcement blocking, but not mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based [, identify the standard under which preservative treatment was made,] and identify doors having a glue bond.
2.3.3 Preservative Treatment

Treat doors scheduled for restrooms, janitor closets and other possible wet locations including exterior doors with a water-repellent preservative treatment and so marketed at the manufacturer's plant.

2.3.4 Adhesives and Bonds

MLIT-SS Ch 16, Sec 7. Use bond as recommended by manufacturer for interior and exterior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.3.5 Prefitting

Provide factory [prefinished] [finished] [and] factory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

2.3.6 Finishes

2.3.6.1 Field Painting

Factory prime or seal doors, and field paint.

2.3.6.2 Factory Finish

Provide doors finished at the factory by the door manufacturer. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.6.3 Plastic Laminate Finish

Factory applied, JIS K 6903, General or Specific purpose type, 1.25 mm minimum thickness. Glue laminated plastic for hollow core doors to wood veneer, plywood, or hardboard backing to form door panel. Provide a combined thickness of laminate sheet and backing of 2.5 mm minimum.

2.3.6.4 Color

Provide door finish colors in accordance with Section 09 06 00 SCHEDULES FOR FINISHES.

2.3.7 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finish[es].

2.4 SOURCE QUALITY CONTROL

Meet or exceed the following minimum performance criteria of stiles fire
doors utilizing standard mortise leaf hinges:

a. Cycle-slam: [Standard Duty Doors: no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of JIS A 1530] [Heavy Duty Doors: no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of JIS A 1530] [Extra Heavy Duty Doors: no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of JIS A 1530].

b. Hinge loading resistance: Averages of ten test samples not less than [Standard Duty doors: 1780 Newton force] [Heavy Duty doors: 2110 Newton force] [Extra Heavy Duty doors: 2440 Newton force] when tested for direct screw withdrawal in accordance with JIS A 1530. Do not use a steel plate to reinforce screw area.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with manufacturer required maximum clearance at sides and top, and a clearance over thresholds per manufacturer recommendation. Provide 10 mm minimum, 11 mm maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 3 mm in 50 mm. Door warp must not exceed 6 mm when measured in accordance with MLIT-SS Ch 16, Sec 7.

3.1.1 Fire[ and Smoke] Doors

Install fire doors in accordance with NFPA 80. [Install smoke doors in accordance with NFPA 105. ]Do not paint over labels.

3.1.2 Prehung Doors

Install doors in accordance with the manufacturer's instructions and details. Provide fasteners for [stops] [and] [casing trim] within 75 mm of each end and spaced 279 mm on center maximum. Provide side and head jambs joined together with a dado or notch of 5 mm minimum depth.

3.1.3 Weatherstripping

Install doors in strict accordance with the door manufacturer's printed installation instructions and details. Weatherstrip exterior swing-type doors at sills, heads and jambs to provide weathertight installation. Apply weatherstripping at sills to bottom rails of doors and hold in place with a brass or bronze plate. Apply weatherstripping to door frames at jambs and head. Shape weatherstripping at sills to suit the threshold. [Meeting stiles of exterior double-doors must be made weathertight by means of [a looped vinyl or neoprene strip in an extruded nonferrous metal housing applied to the edge of one door leaf] [a neoprene, vinyl or spring-bronze weatherstripped astragal secured to the inactive door leaf].]
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ALUMINUM SLIDING GLASS DOORS

11/08

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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

ASTM INTERNATIONAL (ASTM)

JAPANESE INDUSTRIAL STANDARDS (JIS)
JIS A 4702 (2015) Doorsets
JIS H 8601 (1999) Anodic Oxide Coatings on Aluminum and Aluminum Alloys

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM, GOVERNMENT OF JAPAN (MLIT)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings

Aluminum sliding glass doors

Submit drawings for aluminum sliding glass doors [, screens,] and accessories that indicate elevations of each door type, full size sections, thickness, nominal gages of metal, fastenings, proposed method of installation and anchoring, the size and spacing and method of glazing, details of operating hardware, method and material for weatherstripping, type of finish, and screen details.

SD-10 Operation and Maintenance Data

Aluminum sliding glass doors, Data Package 1; ; G[, [____]]

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 TEMPORARY PROTECTIVE COVERING

Prior to shipment from the factory, finished surfaces of aluminum sliding glass doors shall receive a protective covering of waterproof tape, strippable plastic, or cardboard to protect against discoloration and surface damage that may occur during transportation, storage, and construction activities. Also, no coatings or lacquers shall be applied to surfaces to which caulking and glazing compounds must adhere. Covering shall be readily removable after installation.

1.4 DELIVERY AND STORAGE

Inspect aluminum sliding glass doors, [including screens,] hardware and accessories, for damage and unload and store doors upright on platforms in accessible spaces with a minimum of handling. The storage spaces shall be dry, adequately ventilated, free from heavy dust and not subject to combustion products, sources of water or other conditions that could damage the door. Storage spaces shall have easy access for inspection and handling of doors.

1.5 EXTRA STOCK

[Deliver an extra stock of markings for glass panels to the Government for use in future replacement of original markings. The extra stock shall be of the same designs, colors, and materials as the markings installed on this project. Furnish markings in original containers or packages in a quantity not less than [____] percent of the amount of markings to be installed.]

PART 2 PRODUCTS

2.1 ALUMINUM SLIDING GLASS DOORS

Design and construct with sliding panels and fixed panels in the sizes and arrangements indicated and conforming [except frame shall be equipped with thermal barrier]. [Mark panels identically and permanently to visibly interrupt the span of glass. Use markings [of the design and color indicated] [approximately 2500 square millimeters] of opaque, pressure-sensitive vinyl film with precoated adhesive.]
glazing shall be set in aluminum frames and roller assemblies of sufficient strength to withstand lateral live stresses and static load or weight requirements.

2.1.1 Hardware

Sliding door panel shall have a manually operated adjustable latch [operable by latch handle or slide bar from inside only] [operable by a five-pin tumbler cylinder lock on outside and thumb-turn on the inside] [operable by a five-pin tumbler cylinder lock from either side]. Fit sliding screen door panel with a self-latching hook or rotary-type latch operable from [inside only] [both sides]. [Provide pulls for both inside and outside of sliding panel and the sliding screen panel]. [Provide a pull on the inside of the sliding door panel and the sliding screen panel only]. [Provide auxiliary pin lock [bottom] [top and bottom] on inner side of sliding glass door panel opposite manually operated adjustable latch.] Exposed hardware is to be aluminum or stainless steel, color finished to match door color finish.

2.1.2 Glazing

Factory glazed sliding glass doors, including fixed panel, with [double-glazed] glass conforming to JIS R 3222 not less than [6] [_____] mm thick. [Double glazing shall have a minimum condensation resistance factor of [_____] in accordance with JIS A 1514.] Glazing material must be certified by independent testing agency. Set glazing unit in polyvinyl-chloride or synthetic rubber glazing channels. Channels shall be reusable when replacing glass and have mitered or continuous corners. Channels exposed to view shall blend in color with the aluminum frame finish.

2.1.3 Weatherstripping

Provide four sides of each sliding panel and interlocking stiles and jambs with weatherstripping. Weatherstripping shall conform to JIS A 4702 and shall provide maximum protection against the elements and be designed for ease of replacement.

2.1.4 Screens

Provide horizontal sliding aluminum screens in combination with aluminum sliding glass doors. Screen frames shall consist of aluminum shapes of size and design standard with the door manufacturer. Frames shall have removable splines of aluminum or vinyl and shall permit screening fabric replacement. Screening shall be [18 by 16 mesh aluminum conforming to JIS H 4040,] [_____ color] [selected color to match doors]. Install screening with weave parallel with frames and sufficiently tight to present a smooth appearance. Conceal edges of screening in the spline channel. Screens shall be complete with rollers, hardware, and accessories and shall slide on or within tracks provided in the door frame members. Design and assemble doors so that aluminum-to-aluminum contact of moving members will not occur. Provide insect-proofing, formed of wool pile or other suitable material, at interlocking stiles and jambs. Finish on screen frames shall be as specified for doors.

2.1.5 Finish

Before fabrication, clean sliding glass door units and give a [clear (natural) anodized finish] [_____] (color) anodized finish in accordance
with the requirements of the JIS H 8601. The finish thickness shall be [0.01 mm or greater] [0.0175 mm or greater].

2.2 CAULKING AND SEALING

As specified under Section 07 92 00 JOINT SEALANTS.

2.3 FORCED ENTRY RESISTANT DOORS (U.S. PRODUCT ONLY)

In addition to meeting AAMA/WDMA/CSA 101/I.S.2/A440, doors designated forced entry resistant shall conform to ASTM F842.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Doors, Frames, and Accessories

Install doors, frames, framing members, hardware, and accessories in accordance with approved shop drawings and the requirements specified herein. Set frames securely anchored in place to straight, plumb, square, level condition without distortion and in alignment. Install door panels to retain proper weathering contact with frames. Caulk metal-to-metal joints between frame members and remove excess material. Caulking around perimeter of door frame and wall openings to provide weathertight installation shall be accomplished in accordance with MLIT SS Chapter 16 and manufacturer's recommendations. Finished work shall be rigid, neat in appearance, and free from defects. Upon completion, adjust sliding doors to operate properly. Thoroughly clean aluminum frames and glass in accordance with manufacturer's recommendation. Doors damaged prior to completion and acceptance shall be restored to original manufactured condition or replaced with new doors as directed.

3.1.2 Protection of Aluminum from Dissimilar Materials

3.1.2.1 Aluminum to Dissimilar Metals

Prevent aluminum surfaces from contacting dissimilar metals other than stainless steel, zinc, or white bronze by one or a combination of the following:

a. Paint dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply caulking between aluminum and dissimilar metal.

c. Paint dissimilar metal with primer, followed by one coat of aluminum paint or other suitable lead-free coating.

d. Use nonabsorptive tape or gasket in permanently dry locations.

3.1.2.2 Drainage from Dissimilar Metals

Paint dissimilar metals located in areas where their drainage washes over aluminum to prevent the staining of aluminum.

3.1.2.3 Aluminum to Masonry and Concrete

Prevent aluminum surfaces from coming into contact with mortar, concrete, or other masonry materials by applying one coat of heavy-bodied bituminous
paint to the aluminum surfaces.

3.1.2.4 Aluminum to Wood

Prevent aluminum surfaces from coming into contact with wood, treated wood, or similarly absorptive materials by one or a combination of the following methods:

a. Paint aluminum surfaces with two coats of aluminum paint or one coat of heavy-bodied bituminous paint.

b. Paint the wood, treated wood, or other absorptive surfaces with two coats of aluminum paint and seal contiguous joints with caulking compound.

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ALUMINUM WINDOWS
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PART 1  GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E1886 (2013a) Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 4709 (2018) Screens for windows


JIS B 1051 (2014) Coarse And Fine Screws Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel Bolts, Screws and Studs with Specified Property Classes-Coarse Thread and Fine Pitch Thread

JIS H 8601 (1999) Anodic Oxide Coatings on Aluminum and Aluminum Alloys

JIS K 5906 (1998) Aluminum Pigments For Paints
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
  Windows; G[, [_____]]
  Fabrication Drawings

SD-06 Test Reports
  [ Windborne-Debris-Impact Performance ]
  SD-10 Operation and Maintenance Data
  Windows, Data Package 1; G[, [_____]]
  Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 QUALITY ASSURANCE

1.3.1 Qualification of Manufacturer

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of 5 years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.3.2 Shop Drawing Requirements

Take field measurements prior to preparation of drawings and fabrications. Provide drawings that indicate elevations of windows, full-size sections,
thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, [mullion details,] [method and materials for weatherstripping,] [method of attaching screens,] [material and method of attaching subframes,] [stools,] [casings,] [sills,] [trim,] [window cleaner anchors,] installation details, and other related items.

[1.3.3] Engineer's Qualifications for Blast Design

All blast design calculations must be performed by or under the direct supervision of a registered engineer with a minimum of 5 years experience performing blast design. The engineer performing the blast design must be able to demonstrate experience on similar size projects using similar design methods to meet the requirements outlined in this specification.

[1.3.4] Sample Requirements

1.3.4.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.3.4.2 Window Sample Requirements

[Submit one full-size corner of each window type proposed for use. Where screens or weatherstripping is required, fit sample with such items that are to be used, only required for large scale projects with numerous windows.]

1.3.5 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements[ and Antiterrorism Performance Requirements]. A registered Professional Engineer must provide calculations.

Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

1.3.6 Test Report Requirements

Submit test reports for each type of window attesting that identical windows have been tested and meet the requirements specified herein by independent testing agency including test size, [and] minimum condensation resistance factor (CRF)[, and resistance to forced entry].

1.3.7 Certification

Ensure that construction is performed with products that meet or exceed JIS A 4706 requirement.

Each prime window unit must demonstrate that the product complies with JIS A 4706. Certified test reports attesting that the prime window units meet the requirements of JIS A 4706, including test size, will be acceptable in lieu of product labeling.
1.4 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure of at least [_____] pascal.

[1.5.2 Tests

Perform tests by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Submit the results of the tests as certified laboratory reports required herein. For Japanese manufactured windows, provide structural calculations to prove compliance.

Minimum design load for a uniform-load structural test must be 2400 pascal.

Test projected windows in accordance with the applicable portions of the JIS A 1516 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

Test double-hung windows in accordance with the applicable portions of the JIS A 1516 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

1.6 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

1.7 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

1.7.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame, sash or ventilator member for the window types and classification specified in this section.

1.7.2 Air Infiltration

Air infiltration must not exceed the amount established by JIS A 1516 for each window type.
1.7.3 Water Penetration

Water penetration must not exceed the amount established by JIS A 1517 for each window type.

1.7.4 Thermal Performance

Windows shall meet specified Solar Heat Gain Coefficient (SHGC) and Visual Transmittance (VT) or greater.

1.7.4.1 Southern Climate

Windows installed in Climate Zone [1] [2] will have a U-Factor of [1.3] [1.25] [_____] W/m²·°C or less and a SHGC of [0.25] [_____] or less.

1.7.4.2 South-Central Climate

Windows installed within Climate Zone 3 will have a U-Factor of [0.85] [1.25] [_____] W/m²·°C or less and a SHGC of [0.25] [_____] or less.

1.7.4.3 North-Central Climate

Windows installed within Climate Zone 4 will have a U-Factor of [0.85] [1.25] [_____] W/m²·°C or less and a SHGC of [0.36] [_____] or less.

1.7.4.4 Northern Climate

Windows installed within Climate Zone [5] [6] [7] will have a U-Factor of [0.65] [1.25] [_____] W/m²·°C or less and a SHGC of [0.36] [0.41] [_____] or less.

1.7.4.5 Subarctic Climate

Windows installed within Climate Zone 8 will have a U-Factor of [0.45] [1.25] [_____] W/m²·°C or less. There is no SHGC limit for this climate zone.

1.7.5 Life Safety Criteria

Provide windows that conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.7.6 Sound Attenuation

Provide window with sound attenuation with the window glazed with 13 mm air space between two pieces of 6 mm. Provide documentation to support transmission loss properties.

1.7.7 Windborne-Debris-Impact Performance

Exterior window system including glazing must comply with indicated basis or enhanced protection testing requirements in ASTM E1996 for [Wind Zone 1] [Wind Zone 2] [Wind Zone 3] [Wind Zone 4] when tested according to ASTM E1886. Test specimens must be no smaller in width and length than glazing indicated for use on Project and must be installed in same manner as glazing indicated for use on Project.
a. Refer to drawings for classification of window requiring basic or enhanced protection.

[b. Large-Missile Test: For glazing located within 9.1 m of grade.

[c. Small-Missile Test: For glazing located more than 9.1 m above grade.

1.8 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOWS

Provide prime windows that comply with MLIT SS Chapter 16, JIS A 4706 and the requirements specified herein. In addition to compliance with JIS A 4706, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of [_____] when tested in accordance with JIS A 1514. Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with JIS B 1051, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

2.1.1 Awning Windows (AP)

Type AP-[R15] [LC25] [CW30] [AW40] [ [R] [LC] [CW] [AW]- [_____] (Optional Performance Grade)]. Conceal operating mechanism within the frame members or enclose within a metal casing not less than 1.59 mm thick sheet aluminum.

2.1.2 Horizontal Sliding Windows (HS)

Type HS-[R15] [LC25] [CW30] [AW40] [ [R] [LC] [CW] [AW]- [_____] (Optional Performance Grade)].

2.1.3 Fixed Windows (F)

Type F-[R15] [LC25] [CW30] [AW40] [ [R] [LC] [CW] [AW]- [_____] (Optional Performance Grade)].

2.1.4 Forced Entry Resistant Windows

In addition to meeting the requirements of JIS A 4706, windows designated for resistance to forced entry must conform to the requirements per UFC 4-020-01 as applicable.
2.1.5 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.1.6 Caulking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.1.7 Weatherstripping

JIS A 4706. Provide for all ventilating (operable) sash for all windows. Provide woven wool pile weatherstripping 5.3 millimeter thick, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member.

2.1.8 Sash Poles

Seamless aluminum tube, 1.59 mm minimum wall thickness, 25 mm diameter, [_____] m long, with cast aluminum hook and protective cover or tip on the lower end. Finish must match windows.

2.2 FABRICATION

Fabrication of window units must comply with JIS A 4706.

2.2.1 Fasteners

Use window manufacturer's standard for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 2 mm thick.

2.2.2 Adhesives

Provide joint sealants as specified in Section 07 92 00 JOINT SEALANTS. For interior application of joint sealants, comply with applicable regulations regarding reduced VOC's, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.3 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips must be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

2.2.4 Combination Windows

Windows used in combination must be factory assembled of the same class and grade. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

2.2.5 Mullions and Transom Bars

[Provide Mullions between multiple window units to resist two times (2X) glazing resistance in accordance with impact force: [_____] kpa]. Provide Mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit
expansion and contraction and to form a weathertight joint. Where window cleaner anchors are required, reinforce mullions and anchor to adjoining construction so as to provide safe and adequate support.] Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance. [Provide special covers over structural support at mullions as indicated.]

2.2.6 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation. [Furnish extruded aluminum subframe receptors[ and subsill] with each window unit.]

2.2.6.1 Hardware

The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide [stainless steel] hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

2.2.6.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 150 mm from each end and at midpoint.

2.2.6.3 Window-Cleaner Anchors

Provide double head anchors for windows[ indicated][ specified]. Anchors must be stainless steel of size and design required for the window type and application, conforming to JIS B 1220. Provide two anchors for each single window[ and each adjacent fixed glass window unit]. Fasten anchors 1120 mm above the window sill utilizing appropriate methods for the window type and application in accordance with industry safety standards.

2.2.6.4 Window Anchors

Anchoring devices for installing windows must be made of aluminum or stainless steel, or zinc-plated steel conforming to JIS B 1220.

2.2.7 Finishes

Comply with JIS H 8601 for applying and designating finishes. Exposed aluminum surfaces must be factory finished with an[ anodic coating][ or][ organic coating]. [Color must be [_____] [as indicated].] All windows[ for each building] must have the same finish.

2.2.7.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to JIS H 8601. Finish shall be selected from JIS standard.

2.2.7.2 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a[ baked enamel finish
2.2.8 Screens

Provide one insect screen for each operable exterior sash or ventilator. Design screens to be rewirable, easily removable from inside the building, and to permit easy access to operating hardware. Manufacturers standard aluminum frame complying with JIS A 4709. Fabricate frames with mitered or coped joints or corner extrusion, concealed fasteners and removable PVC spline/anchors concealing edge of frame.

2.2.8.1 Insect Screen

Insect screen mesh to be glass-fiber mesh, 18x16 of PVC-coated glass-fiber threads; woven and fused to form a fabric mesh in accordance with a aluminum wire fabric, 18x16 mesh of 0.2794 mm diameter coated aluminum wire.

2.3 SPECIAL OPERATORS

For windows having operating hardware or locking or latching devices located more than 1800 mm above the floor, provide suitably designed operators or locking or latching devices necessary for convenient and proper window operation.

2.3.1 Pole Operators

Poles must be of proper length to permit window operation from 1500 mm above the floor. Provide one pole operator for each room, and one pole hanger for each pole. Locate hangers where directed.

2.3.2 Extension Crank Operators

Provide removable handles for crank-operated rotary-type operators located more than 1800 mm above the floor. Provide one removable handle for each room.

2.3.3 Mechanical Operators

Provide [manual] [electric motor driven] operators for group operation of continuous rows of windows [located [_____] mm above the floor]. Operators must be capable of opening and closing windows without appreciable deflection, vibration or rattle. Provide means of adjustment for transmission lines. Provide operators to control window units in groups [as recommended by the window manufacturer] [or] [as indicated].

2.4 THERMAL-BARRIER WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

a. Aluminum alloy must be 6063-T6.

b. Frame construction, including operable sash, must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner
frame. Metal fasteners, straps, or anchors must not bridge the connection between the inner and outer frame.

c. Operating hardware for each sash must consist of spring-loaded nylon cushion blocks and pin locks designed to lock in predetermined locations.

d. Sash must be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.

e. Operating and storm sash must be factory-glazed with the type of glass indicated and of the quality specified in Section 08 81 00 GLAZING.

2.5 MULLIONS

Provide mullions between multiple-window units where indicated.

Provide profiles for mullions and mullion covers, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members must be fabricated of the materials specified and meet the specified design loading.

2.6 WINDOW CLEANERS' BOLTS

Provide window cleaners' bolts for all windows 2100 millimeter or higher above finished grade, except for windows that can be removed and cleaned from the ground or from a lower roof level without the use of an extension ladder. Provide two bolts for each single window unit and each fixed glass unit. Locate bolts 1120 millimeter above the window sill.

Window cleaners' bolts must be double-head type, corrosion-resistant steel, size and design per manufacturer. Contact side of the bolts must be ground to fit flat against window jambs. Bolts must be factory- or field-attached before windows are set. Reinforce backs of frames to receive bolts with 6 by 150 millimeter corrosion-resistant steel or aluminum plates bolted or welded to the frames at the factory. Special wall anchors must be provided on frames at the point of bolt attachment.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace,
strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials. Do not coat surfaces in contact with sealants after installation with any type of protective material. Do not apply coatings or lacquers to surfaces to which caulking and glazing components must adhere.

3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 11 mm.

3.1.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Verify that products are properly installed, connected, and adjusted.

3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

-- End of Section --
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DIVISION 08 - OPENINGS

SECTION 08 71 00

DOOR HARDWARE

02/16

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-- End of Section Table of Contents --
1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 1541-2 (2016) Building Hardware - Locks and Latches - Part 2: Methods of the Presentation and Grade of Criteria for Practical Performance Item

JIS A 1525 (1996) Doorsets - Repeated and Opening and Closing Test

JIS A 1551 (2014) Test Method for Automatic Door Opener

JIS A 4702 (2015) Doorsets

JIS A 4721 (2005) Automatic Revolving Door - Safety

JIS A 4722 (2017) Power Operated Pedestrian Door Sets - Safety

JIS A 5756 (2013) Preformed Gaskets Used in Buildings - Classification, Specifications and Test Methods

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2018; TIA 18-1; TIA 18-2; TIA 18-3) Life Safety Code
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Manufacturer's Detail Drawings; G[, [____]]

Verification of Existing Conditions; G[, [____]]

Hardware Schedule; G[, [____]]

Keying System; G[, [____]]

SD-08 Manufacturer's Instructions

Installation
SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G[, [_____]]

SD-11 Closeout Submittals

Key Bitting

1.3 SHOP DRAWINGS

Submit manufacturer's detail drawings indicating all hardware assembly components and interface with adjacent construction. [Indicate power components and wiring coordination for electrified hardware.] Base shop drawings on verified field measurements and include verification of existing conditions.

1.4 PRODUCT DATA

Indicate fire-ratings at applicable components. Provide documentation of ABA/ADA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.5 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

<table>
<thead>
<tr>
<th>Hardware Item</th>
<th>Quantity</th>
<th>Size</th>
<th>Reference Publication Type No.</th>
<th>Finish</th>
<th>Mfr Name and Catalog No.</th>
<th>Key Control Symbols</th>
<th>UL Mark (If fire-rated and listed)</th>
<th>BHMA Finish Designation</th>
</tr>
</thead>
</table>

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 KEY BITTING CHART REQUIREMENTS

1.6.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys.

b. Complete listing of all key cuts.

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.
1.7 QUALITY ASSURANCE

1.7.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges,[ pivots,] and closers of one lock, hinge,[ pivot,] or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.7.2 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the Contracting Officer, Contractor, Door Hardware Subcontractor, using Activity and Base Locksmith must meet to discuss and coordinate key requirements for the facility.

1.8 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown on hardware schedule.[ Deliver permanent keys[ and removable cores] to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.]

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware applied to metal [or to prefinished ]doors must be manufactured using a template. Provide templates to door and frame manufacturers in accordance with JIS A 1510-2 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, NFPA 252 for fire tests of door assemblies, ABA/ADA accessibility requirements, and all other requirements indicated, even if such hardware is not specifically mentioned in paragraph HARDWARE SCHEDULE.[ Provide swinging hardware for tin-clad fire doors in accordance with UL 14C. ] Provide Underwriters Laboratories, Inc. labels for such hardware in accordance with UL Bld Mat Dir or equivalent labels in accordance with another testing laboratory approved in writing by the Contracting Officer.

2.3 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark is visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Coordinate electrified door hardware components with corresponding components specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.1 Hinges

Provide in accordance with JIS A 1510-3. Provide hinges that are 114 by 114 mm unless otherwise indicated. Construct loose pin hinges for interior doors and reverse-bevel exterior doors so that pins are non-removable when door is closed. Other anti-friction bearing hinges may be provided in lieu
of ball bearing hinges.

[2.3.1.1 Protection Devices]

Provide full height hand and finger protection device at the hinge-side area opening of doors and gates. Provide hinge-side protection devices on both sides of doors and gates, covering hinges and space between door and frame when doors are in the open position. The installed device must push hand and fingers out of the opening and away from a crushing hazard.

2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with JIS A 1510-2.

2.3.3 Pivots

Provide in accordance with JIS A 1510-3.

2.3.4 Spring Hinges

Provide in accordance with JIS A 1510-3.

2.3.5 Locks and Latches

[ a. At exterior locations provide locksets of full stainless steel type 302 or 304 construction including fronts, strike, escutcheons, knobs, bolts and all interior working parts. Marine Grade I, fully non-ferrous.

b. In non-air-conditioned interior environments or humid interior environments, provide interior locksets on the same Marine Grade I, fully non-ferrous as exterior locksets.

]2.3.5.1 Mortise Locks and Latches

Provide in accordance with JIS A 1541-1.[ Provide factory installed lead lining in locks for lead shielded doors.][ Provide mortise locks with escutcheons not less than 178 by 57 mm with a bushing at least 6 mm long. Cut escutcheons to fit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges.] Provide knobs and roses of mortise locks with screwless shanks and no exposed screws.

2.3.5.2 Bored Locks and Latches

Provide in accordance with JIS A 4702.[ Provide factory installed lead lining in locks for lead shielded doors.]

2.3.5.3 Residential Bored Locks and Latches

Provide in accordance with JIS A 4702. Install locks for exterior doors with threaded roses or concealed machine screws.

[2.3.5.4 Interconnected Locks and Latches

Provide in accordance with JIS A 1541-2.

]2.3.5.5 Hospital Latches

Push–pull latch set as required to meet operational requirements, 13 mm
throw, [70 mm] [127 mm] backset, to fit 161 cutout. Cover approximately 64 by 140 mm, handle approximately 38 by 114 mm, projection approximately 64 mm, covers and handles of stainless steel finish, engraved "PUSH" and "PULL" on handles, push handle pointing up, pull handle pointing down.

2.3.5.6 Auxiliary Locks

Provide lock having a [latch bolt] or [dead bolt] operated by a [key], [paddle [and] [and/or] turn], which is used in addition to a primary lock or latching device to meet operational requirements.

2.3.5.7 Combination Locks

[Key pharmacy door locks separately from building master key system. ]Heavy-duty, mechanical combination lockset with five push buttons, standard sized knobs, 20 mm deadlocking latch, 70 mm backset. Locks to operate by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob operates the latch. Provide a keyed cylinder on the interior to permit setting the combination.[ Provide a keyed [removable core ]cylinder on the exterior to permit bypassing the combination.][ Provide a thumb turn on the interior to activate passage set function so that outside knob operates latch without using the combination.]

2.3.6 Exit Devices

Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide [touch bars in lieu of conventional crossbars and arms.][ Provide escutcheons not less than 178 by 57 mm.]

[ Use stainless steel or bronze base metal with plated finishes. Also include stainless steel fasteners and screws.]

2.3.7 Exit Locks With Alarm

Provide [with full width horizontal actuating bar] for single doors; Type E0431 [with actuating bar] or E0471 [with actuating bar and top and bottom bolts, both leaves active] for pairs of doors, unless otherwise specified.[ Provide terminals for connection to remote indicating panel.][ Provide outside control key. ] Provide door alarms integrated with the fire alarm system in accordance with NFPA 72.

2.3.8 Cylinders and Cores

[Provide cylinders and cores for new locks, including locks provided under other sections of this specification. ]Provide cylinders and cores with [six] [seven] pin tumblers. Provide cylinders from the products of one manufacturer, and provide cores from the products of one manufacturer.[ Rim cylinders, mortise cylinders, and knobs of bored locksets have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.]

[ Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders of Grade 1 products from products of one manufacturer with interchangeable cores that are removable by a special control key. Factory set the cores with [six] [seven] pin tumblers. Submit a core code sheet with the cores.
Provide master keyed cores in one system for this project. Provide construction interchangeable cores.

[For medical projects, key pharmacy door locks separately from building master key system.

2.3.8.1 High Security Cylinders

Provide high security cylinder with locking technology that limits the duplication of unauthorized keys or unauthorized electronic credentials that would operate the locks. High security cylinder must be able to stand up to forcing, drilling, sawing, prying, pulling, plug driving, picking and have corrosion resistance. [High security cylinder to comply with UL 437].

2.3.9 Push Button Mechanisms

Provide in accordance with JIS A 1541-1.

2.3.10 Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.10.1 Electric Strikes and Frame Mounted Actuators

Provide electric strikes and actuators as required to meet operational requirements. Provide electric strikes that [release automatically] [remain secure] [remain maintained] during power failure. [Provide a separate power supply for electric strikes, other locking devices and ancillary parts.] [Provide battery backup for continued operation during power failure.] Provide strikes and actuators with a minimum opening force of 101 kilonewtons (kN).

Provide facility interface devices that use direct current (dc) power to energize the solenoids. Provide electric strikes and actuators that incorporate end-of-line resistors to facilitate line supervision by the system. If not incorporated into the electric strike or local controller, provide metal oxide resistors (MOVs) to protect the controller from reverse current surges.

2.3.10.1.1 Solenoid

Provide actuating solenoid for strikes and actuators that are rated for continuous duty, cannot dissipate more than 12 Watts and must operate on 12 or 24 Volts dc. Inrush current cannot exceed 1 ampere and the holding current cannot be greater than 500 milliamperes. Actuating solenoid must move from fully secure to fully open positions in less than 500 milliseconds.

2.3.10.1.2 Signal Switches

Provide strikes and actuators with signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. Signal switches must report a forced entry to the system.

2.3.10.1.3 Tamper Resistance

Provide strike guards that prevent tampering with the latch bolt of the locking hardware or the latch bolt keeper of the electric strike. Strike
guards to bolt through the door using tamper resistant screws. Provide strike guards made of 3 mm thick brass and that are 286 mm high by 41 mm, with a minimum 4 mm wide offset.

2.3.10.1.4 Coordination

Provide electric strikes and actuators of a size, weight and profile compatible with each specified door frame. Field verify installation clearances prior to procurement.

2.3.10.1.5 Mounting Method

Provide electric strikes and actuators suitable for use with single and double doors, with mortise or rim type hardware specified, and for right or left hand mounting as specified. In double door installations, locate the lock in the active leaf and monitor the fixed leaf.

2.3.10.2 Electrified Mortise Locks

Provide electrified mortise locks that [release automatically] [remain secure] [remain maintained] during power failure. Provide facility interface devices that use dc power to energize solenoids. Provide solenoids, resisters, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

2.3.10.2.1 Power Transfer Hinges

Provide power transfer hinges with each electrified lock that route power and monitoring signals from the lockset to the door frame. Coordinate power transfer hinges with door frames.

2.3.10.3 Card Readers and Keypad Access Control Hardware

Provide devices that are tamper alarmed, tamper and vandal resistant, solid state, and do not contain electronics which could compromise the access control subsystem should the subsystem be attacked. Provide surface, semi-flush, pedestal, or weatherproof mountable devices as specified for each individual location.[ Each device to contain a visual display, either mounted on the face, or on an integral part of the device, to indicate access or exit request processing, request approval, and request denial.] Provide [proximity] [insertion] [swipe through] type card readers capable of reading [magnetic stripe] [high coercivity magnetic stripe] [Wiegand] [Hollerith] [proximity] [Transmissive Infrared] [Keypad] [[____]/Keypad] [Smart Card] [Biometric] [____] type access control cards. Provide keypads that contain an integral 12-digit tactile keyboard with digits [arranged in numerical order]. Provide keypads that are [a standalone device] [or] [integrated into the card reader]. Coordinate access control hardware with corresponding devices and systems specified in Division 28 ELECTRONIC SECURITY SYSTEMS (ESS).

2.3.10.4 Power Operated Pedestrian Door Hardware

Provide in accordance with JIS A 4722.

2.3.10.5 Release Devices

In accordance with JIS A 1510-3.
2.3.10.5.1 Closer Holders

Provide [floor] [door] [header] mounted closer holder devices connected by [separate releasing] [integral releasing] to [fire] [smoke] detecting devices.

2.3.10.5.2 Release Devices

Provide [wall] [floor] [door] mounted [Electromagnetic] [electromechanical] [free swinging] release devices connected to [fire] [smoke] detecting devices.

2.3.10.6 Power Assist and Low Energy Power Operated Doors

Provide in accordance with JIS A 4722.

2.3.10.7 Electromagnetic Locks

Provide electromagnetic locks that do not contain any moving parts and depend solely upon electromagnetism to secure a portal by generating at least 5.3 kN of holding force. The lock must interface with the local processors without external, internal or functional alteration of the local processor. The electromagnetic lock must incorporate an end of line resistor to facilitate line supervision by the system. Provide metal-oxide resistors (MOVs) to protect controllers from reverse current surges, if not incorporated into the electromagnetic lock or local controller.

2.3.10.7.1 Armature

Provide electromagnetic locks with internal circuitry to eliminate residual magnetism and inductive kickback. Provide actuating armature that operates on 12 or 24 Volts dc and cannot dissipate more than 12 Watts. Holding current must be less than 500 milliamperes. Actuating armature must take less than 300 milliseconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

2.3.10.7.2 Tamper Resistance

Provide lock mechanism encased in hardened guard barriers to deter forced entry.

2.3.10.7.3 Mounting Method

Provide electromagnetic lock suitable for use with single and double door with mortise or rim type hardware and compatible with right or left hand mounting.

2.3.10.8 Delayed Egress Locking System

Provide delayed egress product capable of allowing the door to be opened by actuating the lock which is equipped with a 15-second maximum delayed feature including a zero-to-three second pre-delay. The door shall be allowed to close by action of the door closer. Electrically re-lock the system so that the time delay is operative. A force, not to exceed 67 N, shall be continuously applied on the door or release device allowing the door to be opened after not more than 15 seconds.
2.3.10.9 Power and Manual Operated Revolving Pedestrian Doors

Provide in accordance with JIS A 1551 for powered revolving pedestrian doors and JIS A 4721 for manual operated revolving pedestrian doors.

2.3.11 Keying System

Provide[ a [great][grand] master keying system][ an extension of the existing keying system. Existing locks were manufactured by [_____] and [do not] have interchangeable cores.][ Provide[ a construction master keying system][ construction interchangeable cores].][ Provide key cabinet as specified.]

2.3.12 Lock Trim

Provide cast, forged, or heavy wrought construction and commercial plain design for lock trim.

2.3.12.1 Knobs and Roses

Provide in accordance with JIS A 4702 and JIS A 1541-1 for knobs, roses, and escutcheons. For unreinforced knobs, roses, and escutcheons, provide a 1.25 mm thickness. For reinforced knobs, roses, and escutcheons, provide an outer shell thickness of 0.89 mm and a combined total thickness of 1.78 mm, except at knob shanks. Provide knob shanks 1.52 mm thick.

2.3.12.2 Lever Handles

Provide lever handles [where indicated in the Hardware Schedule]. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in JIS A 1541-1 is applied to the lever handle. Provide lever handles return to within 13 mm of the door face.

2.3.12.3 Texture

Provide knurled or abrasive coated knobs or lever handles for doors which are accessible to blind persons and which lead to dangerous areas.

2.3.13 Keys

[Furnish][Provide] one file key, one duplicate key, and one working key for each key change [and for each master [and grand master] keying system]. [Furnish][Provide] one additional working key for each lock of each keyed-alike group.[ [Furnish][Provide] two additional keys for each sleeping room][ [Furnish][Provide] [_____] great grand master keys,][ [_____] construction master keys,] [and [_____] control keys for removable cores].][ [Furnish][Provide] a quantity of key blanks equal to 20 percent of the total number of file keys.] Stamp each key with appropriate key control symbol and "U.S. property - do not duplicate." Do not place room number on keys.

2.3.14 Door Bolts

Provide in accordance with JIS A 4702. Provide dustproof strikes for bottom bolts, except at doors having metal thresholds. Provide automatic latching flush bolts to meet operational requirements.
2.3.15 Closers

Provide in accordance with JIS A 1510-3. Provide with brackets, arms, mounting devices, fasteners, [full size covers, except at storefront mounting,] [pivots,] [cement cases,] and other features necessary for the particular application. Size closers in accordance with manufacturer's printed recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

[ Use stainless steel inside bracketed or door mounted closers on exterior doors. Non-ferrous closers, such as aluminum or cast bronze, are permissible where door utilization is minimal. On interior doors use closers of 302 or 304 stainless steel or non-ferrous materials. On surface-mounted closers use or apply rust inhibiting finish on all ferrous parts. Also apply this finish on concealed closers.

2.3.15.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation in locations that will be visible after installation.

2.3.16 Overhead Holders

Provide in accordance with JIS A 1510-3.

2.3.17 Door Protection Plates

Provide in accordance with JIS A 4702.

2.3.17.1 Sizes of [Armor] [Mop] [and] Kick Plates

50 mm less than door width for single doors; 25 mm less than door width for pairs of doors. Provide [[200] [1200] mm kick plates for flush doors] [and] [125 mm less than height of bottom rail for panel doors]. Provide a minimum [900] [1200] [_____] mm armor plates for flush doors [and] completely cover lower panels of panel doors, except 400 mm high armor plates on fire doors. Provide [100] [150] mm mop plates.

2.3.17.2 Edge Guards

Stainless steel, of same height as armor plates. Apply to [hinge stile] [lock stile] [meeting stiles].

2.3.18 Door Stops and Silencers

Provide in accordance with JIS A 4702. Provide three silencers for each single door, two for each pair.

2.3.19 Padlocks

Provide padlock of [solid extruded brass] [stainless steel]. [Shackle to be cut-resistant]. Provide lock functions consisting of [key retained], [non-key retained], [frangible shackle], [double lockout], [weather cover], [car seal slot].
2.3.20  Thresholds

Use vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.

2.3.21  Weatherstripping Gasketing

Provide in accordance with JIS A 5756. Provide the type and function designation where specified in paragraph HARDWARE SCHEDULE. Provide a set to include head and jamb seals[, sweep strips,] [and, for pairs of doors, astragals]. Air leakage of weatherstripped doors not to exceed [2.19 by 10⁻⁵] [5.48 by 10⁻⁵] cms per minute of air per square meter of door area when tested in accordance with JIS A 1516. Provide weatherstripping with one of the following:

2.3.21.1  Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide [clear (natural)] [bronze] anodized aluminum.

2.3.21.2  Interlocking Type

Zinc or bronze not less than 0.45 mm thick.

2.3.21.3  Spring Tension Type

Spring bronze or stainless steel not less than 0.20 mm thick.

2.3.22  [Lightproofing] [and] [Soundproofing] Gasketing

Provide in accordance with JIS A 5756. Provide adjustable doorstops at heads, jambs and automatic door bottoms in accordance with the hardware set, of extruded aluminum, [clear (natural)] [bronze] anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed cell sponge gasket. Provide door bottoms with adjustable operating rod and silicone rubber or closed cell sponge neoprene gasket. Provide doorstops that are mitered at corners. Provide type and function designation where specified in paragraph HARDWARE SETS.

2.3.23  Rain Drips

Provide extruded aluminum rain drips, not less than 2.03 mm thick, [clear anodized] [bronze anodized] [factory painted] [factory primed] finish. Provide the manufacturer's full range of color choices to the Contracting Officer for color selection.[ Provide rain drips with a 102 mm overlap on each side of each exterior door that is not protected by an awning, roof, eave or other horizontal projection.] Set drips in sealant and fasten with stainless steel screws.

2.3.23.1  Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

2.3.23.2  Overhead Rain Drips

Approximately 38 mm high by 64 mm projection. Align bottom with door frame
rabbet.

2.3.24 Auxiliary Hardware (Other than locks)

Provide in accordance with JIS A 4702.

2.3.25 Sliding and Folding Door Hardware

Provide in accordance with JIS A 1525. Finishes to match other hardware specified herein.

2.3.26 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, as required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of type, quality, size, and quantity appropriate to the specific application. Fastener finish to match hardware. Provide stainless steel or nonferrous metal fasteners in locations exposed to weather. Verify metals in contact with one another are compatible and will avoid galvanic corrosion when exposed to weather.

2.5 FINISHES

Provide in accordance with JIS A 1541-2. Provide hardware in satin stainless steel, unless specified otherwise. Provide items not manufactured in stainless steel in satin chromium plated over brass or bronze, except [aluminum paint] [prime coat] finish for surface door closers, and except satin chromium plated [primed for painting] for steel hinges. Provide hinges for exterior doors in stainless steel finish [or chromium plated brass or bronze finish]. Furnish exit devices in satin chrome finish in lieu of stainless steel finish [except where specified under paragraph HARDWARE SETS]. Match exposed parts of concealed closers to lock and door trim. Match hardware finish for aluminum doors to the doors.

Provide in accordance with JIS A 1541-2. Provide hardware in satin bronze, unless specified otherwise. Finish surface door closers [bronze paint] [prime coat] finish. Provide steel hinges in [satin bronze plated] [primed for painting]. Provide exposed parts of concealed closers finish to match lock and door trim. Match hardware finish for aluminum doors to match the doors. Provide hardware showing on interior of [bathrooms] [shower rooms] [toilet rooms] [washrooms] [laundry rooms] [and kitchens] in bright stainless steel or bright chromium plated.

2.6 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with project requirements, [[(25 hooks)] [(125 hooks)] [(150 hooks)] [(600 hooks)] [(700 hooks)].] [Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.]

PART 3 EXECUTION

3.1 INSTALLATION

Provide hardware in accordance with manufacturers' printed installation
instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weatherstripping Installation

Provide full contact, weathertight seals that allow operation of doors without binding the weatherstripping.

3.1.1.1 Stop Applied Weatherstripping

Fasten in place with color matched sheet metal screws not more than 225 mm on center after doors and frames have been finish painted.

3.1.1.2 Interlocking Type Weatherstripping

Provide interlocking, self adjusting type on heads and jambs and flexible hook type at sills. Nail weatherstripping to door 25 mm on center and to heads and jambs at 100 mm on center.

3.1.1.3 Spring Tension Type Weatherstripping

Provide spring tension type on heads and jambs. Provide bronze nails with bronze. Provide stainless steel nails with stainless steel. Space nails not more than 38 mm on center.

3.1.2 [Lightproofing] [and] [Soundproofing] Installation

Provide as specified for stop applied weatherstripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws[ in expansion sleeves]. For aluminum thresholds placed on top of concrete surfaces, coat the underside surfaces that are in contact with the concrete with fluid applied waterproofing as a separation measure prior to placement.

3.2 FIRE DOORS AND EXIT DOORS

Provide hardware in accordance with NFPA 72 for door alarms, NFPA 80 for fire doors, NFPA 101 for exit doors, and NFPA 252 for fire tests of door assemblies. [Provide tin-clad fire doors in accordance with UL 14C].

3.3 HARDWARE LOCATIONS

Provide as indicated or specified otherwise.


b. Mop Plates: Bottom flush with bottom of door.
3.4 KEY CABINET AND CONTROL SYSTEM

Locate where [directed][indicated]. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Provide complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, errors in cutting and fitting and damage to adjoining work.

3.6 HARDWARE SETS

Provide [hardware for aluminum doors under this section. Deliver Hardware templates and hardware, except field applied hardware, to the aluminum door and frame manufacturer for use in fabricating doors and frames.]

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### SECTION 08 81 00

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)**


**ASTM INTERNATIONAL (ASTM)**

ASTM E2226 (2015a; R 2019b) Standard Practice for Application of Hose Stream

**INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)**


ISO 28278 (2011) Glass in Building - Glass Products for Structural Sealant Glazing

**JAPANESE INDUSTRIAL STANDARDS (JIS)**


Elements - Airborne Sound Insulation


JIS A 5756 (2013) Preformed Gaskets Used in Buildings - Classification, Specifications and Test Methods

JIS A 5758 (2016) Sealants for Sealing and Glazing in Buildings

JIS K 6262 (2013) Rubber, Vulcanized or Thermoplastic - Determination of Compression Set at Ambient, Elevated or Low Temperatures


JIS R 3202 (2011) Float Glass and Polished Plate Glass

JIS R 3205 (2005) Laminated Glass

JIS R 3206 (2014) Tempered Glass

JIS R 3220 (2011) Glass in Building - Silvered, Flat-Glass Mirror


MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORTATION AND TOURISM (MLIT)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


NFPA 257 (2012; ERTA 2017) Standard on Fire Test for Window and Glass Block Assemblies

NFPA 80 (2016; TIA 16-1) Standard for Fire Doors and Other Opening Protectives
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
   Insulating Glass
   Sealants
   Joint Backer

SD-08 Manufacturer's Instructions
   Setting and Sealing Materials
   Glass Setting

SD-11 Closeout Submittals
   Warranty for Insulated Glass Units
     [ Warranty for Polycarbonate Sheet
     ][ Warranty for Monolithic Reflective Glass
     ][ Warranty for Monolithic Opacified Spandrel
   ]

1.3 SYSTEM DESCRIPTION

Fabricate and install watertight and airtight glazing systems to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, or defects in the work. Glazed panels must comply with the safety standards, in accordance with JIS R 3205 for Laminated Glass or JIS R 3206 for Tempered Glass, comply with indicated wind/snow loading in accordance with ISO 28278, and relative displacement requirements in accordance with ASCE 7, section 13.5.9.1. Provide insulated laminated heat-strengthened exterior glazing with a minimum
interlayer thickness as indicated on the drawings or as required to meet performance requirements. [Sloped glazing must comply with MLIT-SS Ch 16, Sec 14.]

1.3.1 Wind Pressure Requirements

Exterior glazing to withstand an allowable wind-loading design pressure of [_____] kPa in Zone [_____] and [_____] kPa in Zone [______]. Zones [_____] and [_____] are defined by ASCE 7-10.

1.3.2 Windborne Debris Requirement

Exterior glazing shall be tested and certified for impact resistance with the window or door as applicable under JIS R 3109 to comply with minimum Missile Type [_____] and ICC IBC Section 1609, Wind Loads or tested and certified for impact resistance under ISO 16932 to comply with minimum Missile Type [_____] and Wind Zone [______].

1.4 QUALITY CONTROL

Submit two 203 by 254 mm samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, [_____] and insulating glass units. Submit three samples of each other material. Samples of plastic sheets must be minimum 125 by 175 mm.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 4 degrees C and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.7 WARRANTY

1.7.1 Warranty for Insulated Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

1.7.2 Warranty for Polycarbonate Sheet

For a 5-year period following acceptance of the work:

a. Warranty Type I, Class A (UV stabilized) sheets against breakage;
b. Warranty Type III (coated, mar-resistant) sheets against breakage and against coating delamination;

c. Warranty Type IV (coated sheet) against breakage and against yellowing;

d. Warranty extruded polycarbonate profile sheet against breakage.

For a 10-year period following acceptance of the work, warranty Type IV against yellowing and loss of light transmission.

[1.7.3 Monolithic Reflective Glass]

Manufacturer must warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty must be signed by manufacturer.

[1.7.4 Monolithic Opacified Spandrel]

Manufacturer must warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty must be signed by manufacturer.

PART 2 PRODUCTS

2.1 PRODUCT SUSTAINABILITY CRITERIA

[2.1.1 Energy Efficient Equipment for Residential Windows]

Provide energy efficient residential windows in accordance with Section 01 33 29 SUSTAINABILITY REPORTING paragraph ENERGY EFFICIENT PRODUCTS.

2.2 GLASS

JIS R 3202, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.2.1 Clear Glass

For interior glazing (i.e., pass and observation windows), 6 mm thick glass should be used.

Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 3 mm float glass for openings up to and including 1.39 square meters, 4.5 mm for glazing openings over 1.39 square meters but not over 2.79 square meters, and 6 mm for glazing openings over 2.79 square meters but not over 4.18 square meters.

2.2.2 Annealed Glass

Annealed glass must be Type I transparent flat type, [Class 1 - clear, ] Quality q3 - glazing select, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to JIS R 3202.

2.2.3 Heat-Absorbing Glass

[Tinted], [_____] mm thick, [blue][green] in color, [_____] percent light transmittance, [_____] percent shading coefficient, conforming to JIS R 3202.
2.2.4 Reflective Coating Vision Glass

JIS R 3221.

2.2.5 Wired Glass

Provide UL listed glass for fire-rated windows rated for [45] [20] minutes when tested in accordance with ASTM E2226. Wired glass must be Type II flat type, Class [1 - translucent] [2 - tinted, heat-absorbing] [3 - tinted, light-reducing], Quality [q7 - decorative] [q8 - glazing], Form [1 - wired and polished both sides] [2 - patterned and wired], [_____] percent light transmittance, [_____] percent shading coefficient, conforming to JIS R 3202. Wire mesh must be polished stainless steel Mesh [1 - diamond] [2 - square] [3 - parallel]. Wired glass for fire-rated windows must bear an identifying UL label or the label of a nationally recognized testing agency, and be rated for [20] [45] minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors must be tested as part of a door assembly in accordance with NFPA 252.

2.2.6 Patterned Glass

[Translucent], [patterned], [decorative], [patterned one side], [patterned two sides], [Linear], [geometric], [random], [special], [_____] percent light transmittance, [_____] percent shading coefficient. [3] [6] mm thick.[ Provide [____].]

2.2.7 Laminated Glass

[JIS R 3205, Laminated glass fabricated from two nominal [3] [_____] mm pieces of flat annealed [ultraclear]; [clear] [_____] glass conforming to JIS R 3202.] [JIS R 3205, Laminated glass fabricated from two nominal [3] [_____] mm pieces of [HS] [FT], flat [heat strengthened] [fully tempered] [clear] [_____] glass conforming to JIS R 3222.] Flat glass to be laminated together with a minimum of 0.75 mm [_____] mm thick, clear [polyvinyl butyral] [ionoplast] [cast-in-place liquid resin] laminate, conforming to requirements of JIS R 3205. The total thickness of nominally 6 [_____] mm. Color to be [clear] [gray] [bronze] [_____]. The total thickness of nominally [_____] mm.

[ Design window glazing using a dynamic analysis[ testing from airblast loading in accordance with ISO 16933, or ISO 16934 by an independent testing agency regularly engaged in blast testing] to prove the glazing will provide performance equivalent to or better than a [low] [very low] [_____] hazard rating in accordance with ISO 16933 for the peak positive pressure of [_____] kilopascals (kPa) and peak positive phase impulse of [_____] kilopascal-millisecond (kPa-msec).

2.2.8 Bullet-Resisting Glass

Fabricated from Type I, Class 1, Quality q3 glass with polyvinyl butyral plastic interlayers between the layers of glass and listed by UL MEAPD as bullet resisting, with a rating Level of [Level 1] [Level 2] [Level 3] [Level 4] [Level 5] [_____] in accordance with UL 752. Provide [_____] [where indicated].
2.2.9 Mirrors

2.2.9.1 Glass Mirrors

Glass for mirrors must be transparent flat type, clear, 6 mm thick conforming to JIS R 3220. Glass must be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating must be highly adhesive pure silver coating of a thickness which must provide reflectivity of 83 percent or more of incident light when viewed through 6 mm thick glass, and must be free of pinholes or other defects. Copper protective coating must be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and must be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint must consist of two coats of special scratch and abrasion-resistant paint, and must be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.10 One-Way Vision Glass (Transparent Mirrors)

6 mm thick, coated on one face with a hard, adherent film of chromium or other approved coating of equal durability. Glass must transmit not less than 5 percent or more than 11 percent of total incident visible light and must reflect from the front surface of the coating not less than 45 percent of the total incident visible light. [Provide [____].]

2.2.11 Tempered Glass

Per fully tempered, uncoated, transparent per JIS R 3222 [2 tinted heat absorbing], [____] mm thick, [____] percent light transmittance, [____] percent shading coefficient conforming to JIS R 3206 or MLIT-SS Ch 16, Sec 14. Color must be [[clear] [bronze] [gray] [____]]. [Provide [____]] [and wherever safety glazing material is indicated or specified].

2.2.12 Heat-Strengthened Glass

HS (heat strengthened), uncoated, [clear JIS R 3222] [tinted heat absorbing ], [____] mm thick. [Provide [____]].

2.2.13 Spandrel Glass

2.2.13.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass must be Kind HS heat-strengthened transparent flat type, coated with a colored ceramic material on No. 2 surface, [____] mm thick, conforming to JIS R 3222. Glass performance must be K-Value/Winter Nighttime [____], shading coefficient [____]. Color must be [____].

2.2.13.2 Film-Opacified Spandrel Glass

Film-opacified spandrel glass must be Kind HS heat-strengthened transparent flat type glass with a polyester or polyethylene film 0.025 mm to 0.127 mm thick attached to No. 2 surface of a sputtered solar-reflective film, conforming to JIS R 3222. Film opacification must be compatible to and specifically developed for application to solar reflective films. Glass performance must be K-Value/Winter Nighttime [____], shading coefficient [____]. Color must be [____].
2.2.13.3 Spandrel Glass With Adhered Backing

Kind HS or FT, ceramic coated, JIS R 3222, [_____] mm thick and must pass the fallout resistance test specified in JIS R 3222. [Provide [______].]

[2.2.14 Fire/Safety Rated Glass

[2.2.14.1 Fire Protection Rated Glass

Clear tempered and meet 16 CFR 1201 Category I (under 0.836 sqm) or II (over 0.836 sqm) impact safety standard. Glass to make [20] [45] minute rating when tested in accordance with NFPA 257 and NFPA 252. Glass to be permanently labeled with appropriate markings.

[2.2.14.2 Fire Resistive Rated Glazing

Fire resistive glass must be laminated, with intumescent interlayer, Type I transparent flat type, Class 1-clear and meet 16 CFR 1201 Category I (under 0.836 sqm) or II (over 0.836 sqm). Glass must have a [60] [90] [120] minute rating when tested in accordance with JIS A 1304. Glass must be permanently labeled with appropriate markings.

2.3 INSULATING GLASS UNITS

[Two][Three] panes of glass separated by a dehydrated airspace[, filled with argon gas][, filled with krypton gas][, filled with aerogel] and hermetically sealed, conforming to ISO 28278. Submit performance and compliance documentation for each type of insulating glass.

[ Insulated glass units must have a Solar Heat Gain Coefficient (SHGC) maximum of [_____] determined according to ISO 15099 and a U-factor maximum of [_____] W per square m by K in accordance with ISO 15099.

[See section[s][_____] for energy performance requirements for glazed systems (glazing and frames).] [Glazed panels must be rated for not less than [26] [30] [35] [_____] Sound Transmission Class (STC) or equivalent Weighted Sound Reduction Index (Rw) when tested for laboratory sound transmission loss according to JIS A 1418 and determined by JIS A 1419.]

Spacer must be black, roll-formed, [thin-gauge, C-section steel] [steel-reinforced butyl rubber] [thermally broken aluminum] [polyurethane and silicon foams], with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal must be compressed polyisobutylene and the secondary seal must be a specially formulated silicone.

The inner light must be clear annealed flat glass JIS R 3205, JIS R 3202 [_____] mm thick, fully tempered, uncoated, transparent, JIS R 3222 [_____] mm thick. The intermediate light must be clear annealed flat glass, JIS R 3202, fully tempered, uncoated, transparent, JIS R 3222 [_____] mm thick. The outer light must be transparent, JIS R 3202, [2 (tinted heat absorbing)], [2 (solar-reflective)], [_____] mm thick, fully tempered, uncoated, clear JIS R 3202 [2 (tinted heat absorbing)][solar-reflective], [_____] mm thick.
2.3.1 Low Emissivity Coatings

Interior and exterior glass panes for Low-E insulating units must be annealed flat glass, Class [1-clear] [2-tinted] with anti-reflective low-emissivity coating or heat-strengthened or fully tempered glass complying with JIS R 3222, Condition C on [No. 2 surface (inside surface of exterior pane) JIS R 3222][No. 3 surface (inside surface of interior pane)], conforming to JIS R 3202. Glass performance must be U value maximum of [_____] [W/m²-K], Solar Heat Gain Coefficient (SHGC) maximum of [______]. Color must be [green] [gray] [bronze] [blue] [______].

2.4 PLASTIC GLAZING

Plastic glazing must have a U-factor maximum of [_____] W per square m by K. [Plastic glazing must include a [16][32][_____] mm layer of aerogel between panels.]

Certificates stating that the plastic glazing meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

2.4.1 Acrylic Sheet

JIS K 6718, [regular] [heat resistant,] [clear and smooth on both sides] [translucent, textured on both sides,] [gray tint,] [bronze tint,] ultraviolet stabilized, [scratch resistant,] [______] [6] [_____] mm thick.

2.4.2 Polycarbonate Sheet

[Clear and smooth both sides] [Translucent, textured both sides] [Gray tint] [Bronze tint] [mar-resistant] [high abrasion resistant], ultraviolet stabilized, [______] mm thick and listed in UL MEAPD as burglar resisting.

2.4.3 Extruded Polycarbonate Profiled Sheet

Provide [double] [triple] walled, surface treated for improved UV resistance, offering thermal efficiency and impact strength.

2.4.4 Bullet-Resistant Plastic Sheet

Cast acrylic sheet or mar-resistant polycarbonate sheet laminated with a special interlayer, and listed in UL 752 as bullet resisting, Class [I] [II] [III], [clear] [______] in color.[ Provide [______].]

2.5 SETTING AND SEALING MATERIALS

Provide as specified in the MLIT-SS Ch 16, Sec 14, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted must be gray or neutral color. Sealant testing must be performed by a qualified testing agency.

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.[ Include cleaning instructions for plastic sheets.]
2.5.1 Putty and Glazing Compound

Provide glazing compound as recommended by manufacturer for face-glazing metal sash. Putty must be linseed oil type. Do not use putty and glazing compounds with insulating glass or laminated glass.

2.5.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.5.3 Sealants

Provide elastomeric [and structural] sealants.

2.5.3.1 Elastomeric Sealant

JIS A 5758. Use for channel or stop glazing [wood] [and] [metal] sash. Sealants must be chemically compatible with setting blocks, edge blocks, and sealing tapes[, with sealants used in manufacture of insulating glass units] [, and with plastic sheet]. Color of sealant must be white.

2.5.3.2 Structural Sealant

JIS A 5758.

2.5.4 Joint Backer

Joint backer must have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.5.5 Glazing Tapes

2.5.5.1 Back-Bedding Mastic Glazing Tapes

Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with JIS A 5758.

2.5.5.2 Expanded Cellular Glazing Tapes

Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with JIS A 5758 as recommended by tape and glass manufacturers.

2.5.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with JIS K 7366. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes must be chemically compatible with the product being set.

2.5.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks must be dense extruded type conforming to JIS A 5756 and JIS K 6262. Edge blocking as recommended by glazing
manufacturer. Provide silicone setting blocks when blocks are in contact with silicone sealant. Profiles, lengths and locations must be as required and recommended in writing by glass manufacturer. Block color must be [black][_____]..

2.5.8 Glazing Gaskets

Glazing gaskets must be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening must be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets must be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Provide glazing gasket profiles as recommended by the manufacturer for the intended application.

2.5.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets must be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to JIS A 5756.

2.5.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets must be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to JIS A 5756.

2.5.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing must be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.5.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers. Use JIS A 1439 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to surface.

2.6 MIRROR ACCESSORIES

2.6.1 Mastic

Mastic for setting mirrors must be a [polymer] [_____] type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Provide mastic compatible with mirror backing paint, and as approved by mirror manufacturer.

2.6.2 Mirror Frames

Provide mirrors with mirror frames (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames must be 32 by 6 by 6 mm continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material must be provided with mirror frames.
2.6.3 Mirror Clips

Provide clips with concealed fasteners of type to suit wall construction material.

PART 3 EXECUTION

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

3.1 PREPARATION

Preparation, unless otherwise specified or approved, must conform to applicable recommendations in MLIT-SS Ch 16, Sec 14 and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, must conform to applicable recommendations in MLIT-SS Ch 16, Sec 14 and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Patterned Glass

Set glass with one patterned surface with smooth surface on the weather side. When used for interior partitions, place the patterned surface in same direction in all openings.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation must conform to applicable recommendations of MLIT-SS Ch 16, Sec 14.

3.2.4 Installation of Wire Glass

Install glass for fire doors in accordance with installation requirements of NFPA 80.
3.2.5 Installation of Heat-Absorbing Glass

Provide glass with clean-cut, factory-fabricated edges. Field cutting will not be permitted.

3.2.6 Installation of Laminated Glass

Sashes which are to receive laminated glass must be weeped to the outside to allow water drainage into the channel.

3.2.7 Plastic Sheet

Conform to manufacturer's recommendations for edge clearance, type of sealant and tape, and method of installation.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass must be clean at the time the work is accepted.[ Clean plastic sheet in accordance with manufacturer's instructions.]

3.4 PROTECTION

Protect glass work immediately after installation. Identify glazed openings with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protect reflective glass with a protective material to eliminate any contamination of the reflective coating. Place protective material far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Remove and replace glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities with new units.

-- End of Section --
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PART 1 GENERAL

1.1 REFERENCES
1.2 SUBMITTALS
1.3 DELIVERY, STORAGE, AND HANDLING

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   3.2 ERECTION TOLERANCES

-- End of Section Table of Contents --
PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

BUILDING STANDARD LAW OF JAPAN

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5505 (2014) Metal Laths
JIS A 6517 (2010) Steel Furrings for Wall and Ceiling in Buildings
JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 3314 (2010) Hot-Dip Aluminum-Coated Steel Sheet and Strip
JIS G 3321 (2012) Molten 55 Percent Aluminum Zinc Alloy Plated Steel Sheet and Strip
JIS G 3505 (2017) Mild Steel Wire Rod

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Metal Support Systems; G[, [______]]

Submit for the erection of metal[ framing,][ furring,][ and][ ceiling suspension systems]. Indicate materials, sizes, thicknesses, and fastenings.

SD-03 Product Data

Metal Support Systems
1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the job site and store in ventilated dry locations permitting easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

PART 2 PRODUCTS

2.1 MATERIALS

Provide steel materials for metal support systems with galvanized coating JIS G 3302, Z18; aluminum coating JIS G 3314, with a plating adhesion amount of 80, or JIS G 3321. Provide support systems, bracing and attachments per Building Standard Law of Japan.

Provide metal support systems containing a minimum of 20 percent recycled content.

2.1.1 Materials for Attachment of Lath

2.1.1.1 Suspended and Furred Ceiling Systems and Wall Furring

JIS A 5505.

2.1.1.2 Non-loadbearing Wall Framing and Furring

JIS A 6517.

2.1.2 Materials for Attachment of Gypsum Wallboard

2.1.2.1 Suspended and Furred Ceiling Systems

JIS A 6517. JIS G 3505 for hanger rod and nut.

2.1.2.2 Nonload-Bearing Wall Framing and Furring

JIS A 6517, but not thinner than [0.45 mm thickness, with 0.85 mm minimum thickness supporting wall hung items such as cabinetwork, equipment and fixtures][0.85 mm thickness regardless of the ASTM certified third party testing statement for equivalent thicknesses].

2.1.2.3 Furring Structural Steel Columns

JIS A 6517.

2.1.2.4 Z-Furring Channels with Wall Insulation

Not lighter than 0.5 mm thick galvanized steel, Z-shaped, with 32 mm and 19 mm flanges and [25] [38] [50] [75] mm furring depth [depth as required by the insulation thickness provided].
PART 3    EXECUTION

3.1    INSTALLATION

3.1.1    Systems for Attachment of Gypsum Board or Lath

Follow manufacturer's instructions.

3.2    ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;
b. Plates and runners: 5 mm in 1.9 meters from a straight line;
c. Studs: 5 mm in 1.9 meters out of plumb, not cumulative; and
d. Face of framing members: 5 mm in 1.9 meters from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

a. Layout of walls and partitions: 6 mm from intended position;
b. Plates and runners: 5 mm in 3.8 meters from a straight line;
c. Studs: 5 mm in 3.8 meters out of plumb, not cumulative; and
d. Face of framing members: 5 mm in 3.8 meters from a true plane.

-- End of Section --
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DIVISION 09 - FINISHES

SECTION 09 29 00

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


GYPSUM BOARD ASSOCIATION OF JAPAN (GRAJ)

GRAM  Gypsum Board Application Manual

JAPAN ADHESIVE INDUSTRY ASSOCIATION (JAIA)

JAIA 4VOC  Voluntary VOC Regulating Rule for Indoor Air Pollution Control

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1408  (2017) Test Methods of Bending and Impact for Building Boards


JIS A 5508  (2009) Nails

JIS A 6005  (2005) Asphalt Roofing Felts

JIS A 6901  (2014) Gypsum Boards


JIS B 1125  (2015) Self Drilling Tapping Screws

JIS Z 2911  (2018) Methods of Test for Fungus Resistance
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- SD-08 Manufacturer's Instructions
- Safety Data Sheets
- SD-10 Operation and Maintenance Data
- Manufacturer Maintenance Instructions

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Do not store gypsum wallboard with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including [______]. Do not store panels near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives. Do not use materials that have visible moisture or biological growth.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of [3] [_____] years of documented successful experience.

1.5 SCHEDULING

[The gypsum wallboard must be taped, finished and primed before the
installation of the highly emitting materials, including [______].] [The gypsum wallboard must be installed after the installation and ventilation period of the highly emitting materials, including [______].]

Commence application only after the area scheduled for gypsum board work is completely weathertight. The heating, ventilating, and air-conditioning systems must be complete and in operation prior to application of the gypsum board. If the mechanical system cannot be activated before gypsum board is begun, the gypsum board work may proceed in accordance with an approved plan to maintain the environmental conditions specified below. Apply gypsum board prior to the installation of finish flooring and acoustic ceiling.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not expose the gypsum board to excessive sunlight prior to gypsum board application. Maintain a continuous uniform temperature of not less than 10 degrees C and not more than 27 degrees C for at least one week prior to the application of gypsum board work, while the gypsum board application is being done, and for at least one week after the gypsum board is set. Shield air supply and distribution devices to prevent any uneven flow of air across the plastered surfaces. Provide ventilation to exhaust moist air to the outside during gypsum board application, set, and until gypsum board jointing is dry. In glazed areas, keep windows open top and bottom or side to side 75 to 100 mm. Reduce openings in cold weather to prevent freezing of joint compound when applied. For enclosed areas lacking natural ventilation, provide temporary mechanical means for ventilation. In unglazed areas subjected to hot, dry winds or temperature differentials from day to night of 10 degrees C or more, screen openings with cheesecloth or similar materials. Avoid rapid drying. During periods of low indoor humidity, provide minimum air circulation following gypsum boarding and until gypsum board jointing complete and is dry.

1.7 FIRE RESISTIVE CONSTRUCTION

Comply with specified fire-rated assemblies for design numbers indicated.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only. Submit Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

2.1.1 Gypsum Board

JIS A 6901.

2.1.1.1 Regular

900 mm wide, [12.5] [15] mm thick, [tapered][, tapered and featured] edges. [Provide tapered and featured edge gypsum board [in Rooms [______] ] [as indicated].]
2.1.1.2 **Foil-Backed**

900 mm wide, [12.5] [15] mm thick, square, [tapered] [tapered and featured] edges.

2.1.1.3 **Type X or Type Z (Special Fire-Resistant)**

900 mm wide, [12.5] [15] mm thick, [tapered] [tapered and featured] edges.

2.1.1.4 **Mold Resistant / Anti-Microbial Gypsum**

JIS Z 2911. 900 mm wide, [12.5] [15] mm thick, square, tapered or beveled edges.

2.1.2 **Gypsum Backing Board**

JIS A 6901, gypsum backing board must be used as a base in a multilayer system.

2.1.2.1 **Regular**

900 mm wide, [12.5] [15] mm thick, square, tapered or beveled edges.

2.1.2.2 **Type Z (Special Fire-Resistant)**

1200 mm wide, [12.5] [15] mm thick, square or tapered edges.

2.1.3 **Regular Water-Resistant Gypsum Backing Board**

2.1.3.1 **Regular**

900 mm wide, [12.5] [15] mm thick, tapered or beveled edges.

2.1.3.2 **Type X or Type Z (Special Fire-Resistant)**

900 mm wide, [12.5] [15] mm thick, tapered or beveled edges.

2.1.4 **Glass Mat Water-Resistant Gypsum Tile Backing Board**

Water absorption rate of less than 5 percent.

2.1.4.1 **Regular**

1200 mm wide, [12.5] [15] mm thick, square, tapered or beveled edges.

2.1.4.2 **Type Z (Special Fire-Resistant)**

900 mm wide, [12.5] [15] mm thick, square, tapered or beveled edges.

2.1.5 **Abuse Resistant Gypsum Board**

900 mm wide, [15] mm thick, tapered edges. Reinforced gypsum panel with imbedded fiber mesh or lexan backing tested in accordance with the following tests. Hard body impact test must attain a maximum indentation depth of 2.5 mm in accordance with JIS A 1408. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Abuse resistant gypsum board, when tested in accordance with ASTM E84, have [a flame spread rating of 25 or less and a smoke developed rating of 50 or less for [_____] [and] [a flame spread rating of 75 or less and a smoke rating of 250 or less for [____]}}]
developed rating of 100 or less for [______].

2.1.5.1 Hard Body Impact Test

Comply with hard body impact test in accordance with JIS A 1408 with a maximum indentation depth of 2.5 mm.

2.1.5.2 Surface Abrasion Test

Comply with test surface abrasion test in accordance with JIS A 1453.

2.1.5.3 Indentation Test

JIS A 1408 for indentation resistance.

2.1.6 Cementitious Backer Units

In accordance with JIS A 5430.

2.1.7 Joint Treatment Materials

JIS A 6914. Product must be low emitting VOC types with VOC limits not exceeding 50 g/L. Provide data identifying VOC content of joint compound. [Use all-purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds must be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.]

2.1.7.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.7.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.7.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.7.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.7.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.8 Fasteners

2.1.8.1 Nails

JIS A 5508.
2.1.8.2 Screws

JIS B 1125 steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.84 mm thick. JIS B 1125 steel drill screws for fastening gypsum board to steel framing members 0.84 to 2.84 mm thick. Provide cementitious backer unit screws with a polymer coating.

2.1.8.3 Staples

1.5 mm thick flattened galvanized wire staples with 11.1 mm wide crown outside measurement and divergent point for base ply of two-ply gypsum board application. Use as follows:

<table>
<thead>
<tr>
<th>Length of Legs</th>
<th>Thickness of Gypsum Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.6 mm</td>
<td>12.5 mm</td>
</tr>
<tr>
<td>31.8 mm</td>
<td>15 mm</td>
</tr>
</tbody>
</table>

2.1.9 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of JIS A 1901 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of JAIA 4VOC registered. Provide aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of JIS A 1901 (limit requirements for either office or classroom spaces regardless of space type). Provide certification or validation of indoor air quality for non-aerosol adhesives applied on the interior of the building (inside of the weatherproofing system). Provide certification or validation of indoor air quality for aerosol adhesives used on the interior of the building (inside of the weatherproofing system).

2.1.9.1 Adhesive for Laminating

[Not permitted.][ Adhesive attachment is not permitted for multi-layer gypsum boards. For laminating gypsum studs to face panels, provide adhesive recommended by gypsum board manufacturer.]

2.1.10 Gypsum Studs

Provide 25 mm minimum thickness and 150 mm minimum width. Studs may be of 25 mm thick gypsum board or multilayers fastened to required thickness. Conform to JIS A 6901 for material and Gypsum Board Application Manual (GRAM) for installation.

2.1.11 Shaftwall Liner Panel

Conform to the UL Fire Resistance or MLIT for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, as indicated.
2.1.12 Accessories

Fabricate from [corrosion protected steel][ or ][plastic] designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges must be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.13 Asphalt Impregnated Building Felt

Provide a 6.7 kg asphalt moisture barrier over glass mat covered or reinforced gypsum sheathing. Conforming to JIS A 6005 for asphalt impregnated building felt.

2.1.14 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 [Gypsum Board] [and] [Framing]

Verify that surfaces of [gypsum board] [and] [framing] to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.1.3 [Masonry] [and] [Concrete] Walls

Verify that surfaces of [masonry] [and] [concrete] walls to receive gypsum board applied with adhesive are dry, free of dust, oil, form release agents, protrusions and voids, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.1.4 Building Construction Materials

Do not install building construction materials that show visual evidence of biological growth.

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturers instructions and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge
joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Surfaces of gypsum board and substrate members may [not ]be bonded together with an adhesive[, except where prohibited by fire rating(s)]. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. [Install [16 mm][_____] gypsum or [13 mm][_____] ceiling board over framing at [610 mm][_____] on center.] Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.2 Application of Two-Ply Gypsum Board to Wood Framing

Apply in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.3 Adhesive Application to Interior Masonry or Concrete Walls

Apply in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.4 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.5 Arches and Bending Radii

Apply in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.6 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board [or water-resistant gypsum backing board] in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.7 Exterior Application

Apply exterior gypsum board (such as at soffits) in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.2.8 Floating Interior Angles

Minimize framing by floating corners with single studs and drywall clips. Locate the attachment fasteners adjacent to ceiling and wall intersections in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions, for [single-ply] [and]
[two-ply] applications of gypsum board to wood framing.

3.2.9 Control Joints

Install expansion and contraction joints in ceilings and walls in accordance with Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions. Fill control joints between studs in fire-rated construction with firesafing insulation to match the fire-rating of construction.

3.2.10 Application of Abuse Resistant Gypsum Board

Apply in accordance with applicable system of Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions. Follow manufacturers written instructions on how to cut, drill and attach board.

3.3 APPLICATION OF CEMENTITIOUS BACKER UNITS

3.3.1 Application

In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply cementitious backer units. Place a 7.6 kg asphalt impregnated, continuous felt paper membrane behind cementitious backer units, between backer units and studs or base layer of gypsum board. Place membrane with a minimum 150 mm overlap of sheets laid shingle style.

3.3.2 Joint Treatment

Gypsum Board Application Manual (GRAM), Gypsum Board Association of Japan or Manufacturer's Instructions.

3.4 FINISHING OF GYPSUM BOARD

Finish plenum areas above ceilings to Level 1. Finish water resistant gypsum backing board to receive ceramic tile to Level 2. Finish walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting to Level 3. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4. Unless otherwise specified, finish all gypsum board walls, partitions and ceilings to Level 5. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use self-adhering fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to Level 5. Apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.
3.4.2  Gypsum Board Finish Levels

3.4.2.1  Level 1

All joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

3.4.2.2  Level 2

All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.

3.4.2.3  Level 3

All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. One additional coat of joint compound shall be applied over all joints and interior angles. Fastener heads and accessories shall be covered with two separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges. Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of final finishes.

3.4.2.4  Level 4

All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compound shall be smooth and free of tool marks and ridges. Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of final finishes.

3.4.2.5  Level 5

All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound trowel applied, or a material manufactured especially for this purpose and applied in accordance with manufacturer's recommendations, applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.

Note: It is recommended that the prepared surface be coated with a drywall primer prior to the application of finish paint.
3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

[3.5.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing]

Apply silicone sealant in a 9.5 mm bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. [Do not place construction and materials behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.]

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall and ceiling framing] in accordance with the specifications contained in [UL Fire Resistance for the Design Number(s) indicated] or [GA 600 for the File Number(s) indicated]. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.8 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

-- End of Section --
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CERAMIC, QUARRY, AND GLASS TILING
08/17

PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 5005 (2009) Crushed Stone and Manufactured Sand for Concrete

JIS A 5209 (2010) Ceramic Tiles

JIS A 5403 (1989) Asbestos Cement Sheets

JIS A 5505 (2014) Metal Laths

JIS A 5548 (2015) Interior Organic Adhesives for Ceramic Tiles


JIS A 6022 (2010) Stretchy Asphalt Roofing Felts (Synthetic Fiber Base)


JIS R 5210 (2009) Portland Cement
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Detail Drawings; G

SD-10 Operation and Maintenance Data
   Installation; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

1.3.1.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by providing the certification or validation by other third-party program that products meet the requirements of this Section. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 QUALITY ASSURANCE

Provide installers having a minimum of two years experience with a company specializing in performing the type of work described. Each type and color of tile to be provided from a single source. Each type and color of mortar, adhesive, and grout to be provided from the same source.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship tiles in sealed packages and clearly marked with the grade, type of tile, producer identification, and country of origin. Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 10 degrees C and rising. Maintain temperature above 10 degrees C while the work is being performed and for at least 7 days.
after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.8 EXTRA MATERIALS

Supply an extra 2 percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Provide tiles that comply with JIS A 5209 and are standard grade tiles. Provide a minimum breaking strength for floor tile in accordance with JIS A 1509-4. Provide exterior building tile for cold climate projects that is approved by the manufacturer for exterior use in accordance with JIS A 1509-9 and JIS A 5209. Provide floor tiles with a wet dynamic coefficient of friction value per JIS A 5209 requirements. Provide glazed floor tile with commercial rating by the manufacturer per JIS A 1509-8, for visible abrasion resistance as related to foot traffic. For materials like tile, accessories, and transition strips submit samples of sufficient size to show color range, pattern, type and joints. Submit manufacturer's catalog data. Tiles and tile works shall comply with MLIT-SS Chapter 11.

2.1.1 Porcelain Tile

Provide [[unglazed] [ or ] [glazed],] [ rectified] porcelain tile, [cove] [bullnose] base and trim pieces with color extending uniformly through the body of the tile]. [Provide tile with a [V0] [V1] [V2] [V3] [V4] aesthetic classification. Blend tiles in factory and in packages to have same color range and continuous blend for installation.] Provide nominal tile size(s) of [150 by 150] [300 by 300] [450 by 450] [300 by 450] [_____] mm and [8] [10] [_____] mm thick. Provide a 0.50 percent maximum water absorption in accordance with JIS A 1509-3.

Provide Porcelain Tiling Materials that contain a minimum of 10 percent recycled content.

2.1.2 Quarry Tile

Furnish an unglazed quarry tile, [cove] [bullnose] base and trim pieces. Provide tile with [smooth] [abrasive] surface. Provide nominal tile size(s) of [150 by 150] [_____] mm and 13 mm thick. Provide maximum water absorption in accordance with JIS A 5209 or JIS A 1509-3.

Provide Quarry Tiling Materials that contain a minimum of 10 percent recycled content.

2.1.3 Mosaic Tile

Furnish [unglazed] [glazed], mosaic tile[, [cove] [bullnose] [base] and trim composed of [natural clay] [porcelain]. Blend tiles in factory and in packages to have same color range and continuous blend for installation.] Provide [nominal tile size(s) of [25 by 25] [25 by 50] [50
Provide porcelain mosaics with a water absorption up to 0.50 percent.
[Provide natural clay mosaics with a water absorption up to [3.0] [_____] percent] per JIS A 1509-3.

Provide Mosaic Tiling Materials that contain a minimum of 3 percent recycled content.

2.1.4 Glass Tile

Furnish glass mosaic tile that requires thermal shock resistance and can withstand the range of temperatures outdoors. Provide nominal tile size(s) of [25 by 25] [_____] mm.

2.1.5 Glazed Wall Tile

Furnish glazed wall tile that has cushioned edges and trim with lead-free [bright] [matte] finish. Provide nominal tile size(s) of [106 by 106] [106 by 150] [150 by 150] mm.

2.1.6 Accessories

Provide built-in type accessories of the same materials and finish as the wall tile. Provide accessories as follows:

<table>
<thead>
<tr>
<th></th>
<th>Quantity</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recessed soap holders</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>Tumbler holders</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>Combination tumbler and toothbrush holders</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>Towel bars, [stainless steel] [ceramic] [600] [750] mm long, two towel posts</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>Robe hooks</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>Roll paper holder</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>Recessed soap holder and hand hold combination</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

2.2 SETTING-BED

Submit manufacturer's catalog data. Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to JIS A 5005, for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to JIS R 5210, for cement, Type I, white for wall mortar and gray
for other uses.

2.2.3 Sand

Conform to JIS A 5005, for sand.

2.2.4 Hydrated Lime

Conform to JIS A 6902, for hydrated lime.

2.2.5 Metal Lath

Conform to JIS A 5505, for flat expanded type metal lath, and weighing a minimum 1.4 kg/square meter.

2.2.6 Reinforcing Wire Fabric

Conform to JIS G 3551 for wire fabric. Provide [50 by 50 mm mesh, 16/16 wire] [or] [38 by 50 mm mesh, 16/13 wire].

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

[Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting formaldehyde emission rate below 0.005 mg/m2h or meeting requirements of JIS/JAS F***.]

2.4.1 Dry-Set Portland Cement Mortar

MLIT-SS Chapter 11 Tile Work.

2.4.2 Latex-Portland Cement Mortar

MLIT-SS Chapter 11 Tile Work.

2.4.3 Ceramic Tile Grout

MLIT-SS Chapter 11 Tile Work; petroleum-free and plastic-free [sand portland cement grout] [dry-set grout] [latex-portland cement grout] [commercial portland cement grout].

2.4.4 Organic Adhesive

MLIT-SS Chapter 11 Tile Work. Comply with JIS A 5557 for exterior tile and JIS A 5548 for interior tile.

2.4.5 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Grout sealant must not change the color or alter the appearance of the grout. Refer to Section 07 92 00 JOINT SEALANTS.

[Provide sealants used on the interior of the building (defined as inside of the weatherproofing system) meeting formaldehyde emissions rate below 0.005 mg/m2h or meet the requirements of JIS/JAS F****.]
2.5 SUBSTRATES

2.5.1 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with MLIT-SS Chapter 11 Tile Work. Furnish [6.35] [12.7] mm thick cementitious backer units.

2.5.2 Glass Mat Gypsum Backer Panel

Provide glass mat water-resistant gypsum backer board, for use as tile substrate over wood subfloors, in accordance with JIS A 5403. Provide [6.35][12.7] mm thick glass mat gypsum backer board.

2.6 TRANSITION STRIPS

Provide [clear] [_____] anodized aluminum transitions between tile and carpet or resilient flooring. Provide types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified [marble transitions appropriate for conditions].

2.7 MEMBRANE MATERIALS

Conform to JIS A 6022, Type 1 for 33 kg waterproofing membrane, asphalt-saturated building felt.

2.8 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture in accordance with [Section 09 06 00 SCHEDULES FOR FINISHES][as indicated][[_____. Color listed is not intended to limit the selection of equal colors from other manufacturers]. [Provide floor patterns as specified on the drawings.]

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of MLIT-SS Chapter 11 Tile Work for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>WALLS</th>
<th>FLOORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry-Set Mortar</td>
<td>3 mm in 2.4 meter</td>
<td>3.0 mm in 3 meter</td>
</tr>
<tr>
<td>Organic Adhesives</td>
<td>3 mm in 2.4 meter</td>
<td>1.5 mm in 1 meter</td>
</tr>
<tr>
<td>Latex Portland Cement Mortar</td>
<td>3 mm in 2.4 meter</td>
<td>3.0 mm in 3 meter</td>
</tr>
<tr>
<td>Epoxy</td>
<td>3 mm in 2.4 meter</td>
<td>3.0 mm in 3 meter</td>
</tr>
</tbody>
</table>

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Close space, in which tile
is being set, to traffic and other work. Keep closed until tile is firmly set. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar. Do not walk or work on newly tiled floors without using kneeling boards or equivalent protection of the tiled surface. Keep traffic off horizontal portland cement mortar installations for at least 72 hours. Keep all traffic off epoxy installed floors for at least 40 hours after grouting, and heavy traffic off for at least 7 days, unless otherwise specifically authorized by manufacturer. Dimension and draw detail drawings at a minimum scale of 6 mm = 300 mm. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern [elevations][ and ][floor plans]. Submit manufacturer's preprinted installation instructions.

Do not install building construction materials that show visual evidence of biological growth.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the MLIT-SS Chapter 11 Tile Work, method [_____] and with grout joints [[as recommended by the manufacturer for the type of tile] of [_____] mm]. [Install thinner wall tile flush with thicker wall tile applied on same wall and provide installation materials as recommended by the tile and setting materials manufacturer's to achieve flush installation.]

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 0.102 mm polyethylene membrane, metal lath, and scratch coat.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use [Dry-set] [or] [Latex-Portland Cement] to install tile in accordance with MLIT-SS Chapter 11 Tile Work. Use Latex Portland Cement when installing porcelain ceramic tile.

3.3.3 Organic Adhesive

Conform to JIS A 5557 for exterior tile and JIS A 5548 for interior tile for the organic adhesive installation of ceramic tile.

3.3.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with MLIT-SS Chapter 11 Tile Work. [Provide and apply manufacturer's standard [_____] product for sealing grout joints in accordance with manufacturer's recommendations.]

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with MLIT-SS Chapter 11 Tile Work method
[_____] and with grout joints [as recommended by the manufacturer for the type of tile] [of [_____] mm]. Install shower receptors in accordance with manufacturer recommendations.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Install in accordance with MLIT-SS Chapter 11 Tile Work. Provide minimum 6.35 mm to maximum 9.53 mm.

3.4.2 Dry-Set and Latex-Portland Cement

Use [dry-set] [or] [Latex-Portland cement] mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with Install in accordance with MLIT-SS Chapter 11 Tile Work. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Resinous Grout

When resinous grout is indicated, grout quarry tile with either furan or epoxy resin grout. Rake and clean joints to the full depth of the tile and neutralize when recommended by the resin manufacturer. Install epoxy resin grout in conformance with MLIT-SS Chapter 11 Tile Work. Install resin grout in accordance with manufacturer's printed installation instructions. Provide a coating of wax applied from the manufacturer on all tile installed and furan resin. Follow manufacturer's printed installation instructions of installed resin grout for proportioning, mixing, installing, and curing. Maintain the recommended temperature in the area and on the surface to be grouted. Protect finished grout of grout stain.

3.4.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with MLIT-SS Chapter 11 Tile Work. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.4.5 Waterproofing

Shower pans are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. Conform to the requirements of Section 07 12 00 BUILT-UP BITUMINOUS WATERPROOFING for waterproofing under concrete fill.

3.4.6 Concrete Fill

Provide a 24.1 MPa concrete fill mix to dry as consistency as practicable. [Compose concrete fill by volume of 1 part Portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mix with water to as dry a consistency as practicable.] Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 50 mm. Tie laps together with 1.3 mm wire every 250 mm along the finished edges and every 150 mm along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance between the under-floor surface and the finished tiles floor surface is a minimum of 50 mm, and of the same thickness that the mortar
setting-bed over the concrete fill with the thickness required.

3.5 INSTALLATION OF TRANSITION STRIPS

Install transition strips where indicated, in a manner similar to that of the ceramic tile floor and as recommended by the manufacturer. Provide thresholds full width of the opening. Install head joints at ends not exceeding 6 mm in width and grouted full.

3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.6.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 7 to 11 m each way in large interior floor areas and 3 to 5 m each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.7 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles. Submit copy of manufacturer's printed maintenance instructions.

-- End of Section --
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PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5758  (2016) Sealants for Sealing and Glazing in Buildings


JIS A 6301  (2007) Sound Absorbing Materials

JIS B 1168  (1994) Eyebolts

JIS G 3537  (2011) Zinc-coated steel wire strands

JIS G 4309  (2013) Stainless Steel Wires

JIS G 5111  (1991) High Tensile Strength Carbon Steel castings and low alloy steel castings for structural purposes

JIS H 8610  (1999) Electroplated-Coatings of Zinc on Iron or Steel
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G[ , [_____]]

[1.3 ADHESIVES AND SEALANTS

Provide products certified to meet indoor air quality requirements by providing the certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 16 degrees C nor more than 29 degrees C and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.6 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.
1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.8 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. Coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc., shown on the drawings. The Contractor is responsible for all associated labor and materials and for the final assembly and performance of the specified work and products are used. The location and extent of acoustical treatment must be as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

2.1.1 Fire Resistive Ceilings

Rate acoustical ceiling systems, indicated as fire resistant, for fire endurance as specified when tested in accordance with ASTM E119. Test suspended ceiling with a specimen [roof][floor] assembly representative of the indicated construction, including mechanical and electrical work within ceiling space openings for light fixtures, and air outlets, and access panels. Provide ceiling assembly rating for [[1][1-1/2][2][3][4] hour [concealed grid system][exposed grid system]][as shown on drawings]. Provide acoustical units with a flame spread of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E84.

2.1.2 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of [36] for [_____] [and _____ for ____]. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

2.1.3 Ceiling Sound Absorption

Determine the sound reduction rate in accordance with JIS A 1409.
2.1.4 Light Reflectance

Light reflectance to be 0.75 or above.

2.2 ACOUSTICAL UNITS

Submit two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to JIS A 6301 and the following requirements:

2.2.1 Units for Exposed-Grid System [A] [____]

2.2.1.1 Type

[III (non-asbestos mineral fiber with painted finish). Provide Type III Acoustical Ceiling Tiles containing a minimum of 30 percent recycled content.]

[IV (non-asbestos mineral fiber with membrane-faced overlay). Provide Type IV Acoustical Ceiling Tiles containing a minimum of 60 percent recycled content.]

[IX (mineral fiber with scrubbable finish). Provide Type IX Acoustical Ceiling Tiles containing a minimum [50] [____] percent recycled content.]

[X (mineral composition with plastic membrane).]

[XI (mineral fiber with fabric faced overlay).]

[XII (fiberglass base with membrane-faced overlay). Provide Type XII Acoustical Ceiling Tiles containing a minimum of [25] [____] percent recycled content.]

2.2.1.2 Flame Spread

Class A, 25 or less

2.2.1.3 Pattern

[A] [B] [C] [D] [E] [F] [G] [I] [J] [K] [____]

2.2.1.4 Minimum NRC

[0.75] [____] in open office areas; [0.60] [____] in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; [0.50] [____] in all other rooms and areas.

2.2.1.5 Minimum Light Reflectance Coefficient

[LR-1, 0.75 or greater] [____]

2.2.1.6 Nominal Size

[600 by 1200] [____] mm

2.2.1.7 Edge Detail

[Square] [Reveal] [Trimmed and butt] [____]
2.2.1.8 Finish
Factory-applied [standard finish] [color finish].

2.2.1.9 Minimum CAC
[40] [36]

2.2.2 Units for Concealed-Grid System [A] [_____]

2.2.2.1 Type

[III (non-asbestos mineral fiber with painted finish). Provide Type III Acoustical Ceiling Tiles containing a minimum of 30 percent recycled content.]

[IV (non-asbestos mineral fiber with membrane-faced overlay). Provide Type IV Acoustical Ceiling Tiles containing a minimum of 60 percent recycled content.]

[IX (mineral fiber with scrubbable finish). [Provide Type IX Acoustical Ceiling Tiles containing a minimum of [50][_____] percent recycled content.]]

[X (mineral composition with plastic membrane).]

[XI (mineral fiber with fabric faced overlay).]

[XII (fiberglass base with membrane-faced overlay). [Provide Type XII Acoustical Ceiling Tiles containing a minimum of [25][_____] percent recycled content.]]

2.2.2.2 Flame Spread
Class A, 25 or less

2.2.2.3 Pattern
[A] [B] [C] [D] [E] [F] [G] [I] [J] [K] [_____]

2.2.2.4 Minimum NRC
[0.50] [_____]

2.2.2.5 Minimum Light Reflectance Coefficient
[LR-1, 0.75 or greater] [_____]

2.2.2.6 Nominal Size
[300 by 300] [_____] mm

2.2.2.7 Edge Detail
[Beveled] [Square]

2.2.2.8 Joint Detail
[kerfed and rabbeted] [tongue and grooved]
2.2.2.9 Finish

Factory-applied [standard finish] [color finish]

2.2.2.10 Minimum CAC

[40] [_____

2.2.3 Metal Pans [A] [_____

2.2.3.1 Type

[V, steel.]

[VI, stainless steel.]

[VII, aluminum perforated pans with acoustical, non-asbestos, insulation backing.]

2.2.3.2 Flame Spread

Class: A, 25 or less

2.2.3.3 Pattern

[A] [C] [I] [_____

2.2.3.4 Minimum NRC

[0.75] [_____] in open office areas; [0.60] [_____] in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; [0.50] [_____] in all other rooms.

2.2.3.5 Minimum Light Reflectance Coefficient

[LR-1, 0.75 or greater] [_____

2.2.3.6 Nominal Size

[600 by 600] [_____] mm

2.2.3.7 Edge Detail

Manufacturer's standard.

2.2.3.8 Joint Detail

[Beveled] [_____

2.2.3.9 Finish

Factory-applied standard finish

2.2.3.10 Pads

[Completely enclosed, of material and thickness required for acoustical and fire test ratings] [_____].
2.2.4 Impact/Abrasion Resistant Units

2.2.4.1 Type

Non-asbestos mineral composition with a hardened mineral surface and factory applied white paint finish. Provide a surface resistant to impact and abrasion.

2.2.4.2 Flame Spread

Class A, 25 or less

2.2.4.3 Pattern

[_____]  

2.2.4.4 Minimum NRC

[0.50]  [____].

2.2.4.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.2.4.6 Nominal Size

[300 by 300] [600 by 600] [600 by 1200] mm

2.2.4.7 Edge Detail

[Square] [Beveled]

2.2.4.8 Joint Detail

[Trimmed and butted] [Kerfed and rabbeted]

2.2.5 Humidity Resistant Composition Units

2.2.5.1 Type

Non-asbestos mineral or glass fibers bonded with ceramic, moisture resistant thermo-setting resin, or other moisture resistant material and having a factory applied white paint finish. Provide panels that do not sag or warp under conditions of heat, high humidity or chemical fumes.

2.2.5.2 Flame Spread

Class: A, 25 or less

2.2.5.3 Pattern

[____]

2.2.5.4 Minimum NRC

Minimum [0.50] [____].
2.2.5.5 Minimum Light Reflectance Coefficient
   LR-1, 0.75 or greater

2.2.5.6 Nominal Size
   [600 by 1200] [_____] mm

2.2.5.7 Edge Detail
   Square

2.2.6 Metal Faced Composition Units

2.2.6.1 Type
   [Type V (Steel facings with non-asbestos mineral composition absorbent backing)].
   [Type VI (Stainless steel facings with non-asbestos mineral composition absorbent backing)]
   [Type VII (Aluminum facings with non-asbestos mineral composition absorbent backing) with [anodized] [baked enamel] [acrylic] finish color [white] [_____]].

2.2.6.2 Flame Spread
   Class: A, flame spread 25 or less

2.2.6.3 Pattern
   [____]

2.2.6.4 Minimum (NRC)

   [0.75] [_____] in open office areas. [0.60] [_____] in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated.
   [0.50] [_____] in all other rooms and areas.

2.2.6.5 Minimum Light Reflectance Coefficient
   LR-1, 0.75 or greater

2.2.6.6 Nominal Size
   600 by [600] [1200] mm

2.2.6.7 Edge Detail
   Square

2.2.6.8 Joint Detail
   Trimmed and butted

2.2.7 Unit Acoustical Absorbers
   Absorbers must be individually mounted sound absorbing plaques composed of
glass fibers or non-asbestos mineral fibers and having a NRC range of not less than 0.60 - 0.70 when tested in accordance with JIS A 1409 and reported as a 4 frequency average.

2.3 SUSPENSION SYSTEM

Provide [[standard] [fire-resistive] [snap-in metal pan]] [[exposed-grid] [indirect hung concealed H and T or Zee] [direct hung, concealed, downward access] [direct hung, concealed, upward access]] [[standard width flange] [narrow width flange] [narrow width slotted flange]] [as shown on drawings] suspension system conforming to JIS A 1445 [for intermediate-duty systems] [for heavy-duty systems]. Provide surfaces exposed to view of [aluminum or [galvanized ]steel with a factory-applied [white] [black] [color] baked-enamel finish] [aluminum with a clear anodized finish] [aluminum with colored factory-applied vinyl paint finish]. Provide wall molding having a flange of not less than [23 mm] [______]. Provide [inside and outside corner caps] [[standard] [overlapped] [mitered] corners]. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the [guidance in UFC 3-310-04 and ASTM E580/E580M or JIS A 1445] [contract drawings], and in accordance with "Practical Guide on the Technical Standards concerning Measures to Prevent the Fall of Buildings" based on MLIT Notification No. 771 of the Ministry of Land, Infrastructure, Transport and Tourism.

Provide Suspension System containing a minimum of 15 percent recycled content.

2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 1330 N ultimate vertical load without failure of supporting material or attachment.

2.4.1 Wires

Conform wires to JIS G 3537, [JIS G 4309 condition annealed stainless steel, [2.0] [_____] mm in diameter.]

2.4.2 Straps

Provide straps of 25 by 5 mm galvanized steel with a light commercial zinc coating or JIS G 5111 with an electrodeposited zinc coating conforming to JIS H 8610.

2.4.3 Rods

Provide 5 mm diameter threaded steel rods, zinc or cadmium coated.

2.4.4 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with JIS B 1168. Eyebolt size must be a minimum [______] [7] mm, [zinc coated][cadmium plated].

2.4.5 Anchorage Devices

Comply with JIS A 1445 for anchorage devices for [eyebolts] [machine screws] [wood screws]. Where aluminum is in contact with concrete, coat
aluminum with bituminous paint or where exposed, with a chromatic primer and 2-coats of enamel paint.

2.5 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 300 by 300 mm or more than 300 by 600 mm.

a. Attach an identification plate of 0.8 mm thick aluminum, 19 mm in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.

b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 25 mm diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer. Code identification system is as follows:

1. Fire detection/alarm system
2. Air conditioning controls
3. Plumbing system
4. Heating and steam systems
5. Air conditioning duct system
6. Sprinkler system
7. Intercommunication system
8. Nurse's call system
9. Pneumatic tube system
10. Medical piping system
11. Program entertainment
12. Telephone junction boxes
13. Detector X-ray
14. [____]

2.6 ADHESIVE

Use adhesive as recommended by tile manufacturer.

2.7 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling
suspension system components to inhibit corrosion.

2.8 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated.

2.9 ACOUSTICAL SEALANT

Conform acoustical sealant to JIS A 5758, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with JIS A 1445 and in accordance with "Practical Guide on the Technical Standards concerning Measures to Prevent the Fall of Buildings" based on MLIT Notification No. 771 of the Ministry of Land, Infrastructure, Transport and Tourism and as specified herein. The suspension system shall conform to allowable stress performance per the static pressurization test designed by the Japan Ministry of Construction. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 150 mm from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.
3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 75 mm from ends of each length and not more than 400 mm on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 5 kg/square meter or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Ensure that contact area of each daub is at least 50 mm diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the Contracting Officer, on 1220 by 1220 mm pallets not higher than 1220 mm. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

--- End of Section ---
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PART 1 GENERAL

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 5536 (2015) Adhesives for Resilient Textile or Laminate Floor Coverings

JIS A 5705 (2010) Polyvinyl Chloride Floorcoverings

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories; G[, [_______]]

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories; G[, [_______]]
1.3 JAPAN PUBLIC BUILDING CONSTRUCTION STANDARDS

Follow MLIT SS Chapter 19 for interior finishing works.

1.4 INDOOR AIR QUALITY

1.4.1 Floor Covering Materials

Provide [Vinyl Composition Tile][Sheet Vinyl Flooring][Rubber Tile][Rubber Sheet Flooring][Luxury Vinyl Tile][Solid Vinyl Tile][Sheet Linoleum][Linoleum Tile][Cork Flooring], and wall base products certified to meet indoor air quality requirements of third-party programs.

1.4.1.1 Adhesives, Caulking and Sealants

Provide products certified to meet indoor air quality requirements per JIS A 1901 providing the certification or validation by other third-party programs that products meet the requirements of this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 20 degrees C and below 30 degrees C, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions, including [______]. Do not store exposed rubber surface materials in occupied spaces. [Do not store [______] near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.]

1.6 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 20 degrees C and below 30 degrees C for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 13 degrees C thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.7 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.
1.9 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles. Provide extra wall base material composed of 6 m of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE [TYPE [A][______]]

Conform to JIS A 5705, asbestos-free, [300] [______] mm square and [2.4] [3.2] mm thick. Provide color and pattern uniformly distributed throughout the thickness of the tile.

[ Provide Vinyl Composition Tile containing a minimum of 10 percent recycled content. ]

2.2 SHEET VINYL FLOORING [TYPE [A] [______]]

Conform to JIS A 5705 and a minimum [1800 mm] [3660 mm] wide. Extend color and pattern through the total thickness of the material. As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.3 LUXURY VINYL TILE [TYPE [A][______]]

Conform to JIS A 5705 printed film with a minimum wear layer thickness [0.50 mm (20 mil)][0.70 mm (30 mil)][______] and minimum overall thickness [[2.5 mm] [or] [3 mm]] [5 mm [with non slip/skid backing]]. Provide[300 by 600] [______] mm][300] [400] [450] [600] [900] [______] mm square][______] tile.[ Provide tile with a factory protective finish that enhances cleanability and durability.]

2.4 SOLID VINYL TILE [TYPE [A][______]]

Conform to JIS A 5705 Class I monolithic (minimum wear layer thickness 3 mm and minimum overall thickness 3 mm, Type [A (smooth)] [B (embossed)]. Provide [300] [400] [450] [600] [900] [______] mm square tile.

2.5 WALL BASE

Provide [100] [150] mm high and a minimum 3.175 mm thick wall base. Provide [preformed] [job formed] corners in matching height, shape, and color.

2.6 INTEGRAL COVE BASE

Extend integral coved base for [(sheet vinyl) [and] [sheet linoleum] flooring up the wall [100] [150] mm]. Provide a [vinyl] [or] [rubber] [clear anodized aluminum], [square] [round] cap strip and vinyl, rubber, or wood fillet strip with a minimum radius of 19 mm for integral coved bases [at perimeter and fixed vertical interruptions to flooring] [as shown]. Provide integral cove of the same material as flooring. [Provide inside and outside corner protectors of [______]-colored anodized aluminum] [clear anodized aluminum] [or] [plastic] approved by flooring manufacturer.]
2.7 STAIR TREADS, RISERS AND STRINGERS

Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.

2.8 MOULDING

Provide tapered mouldings of [vinyl] [or] [rubber] [[____]-colored anodized aluminum] [clear anodized aluminum] and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 6 mm. Provide bevel change in level between 6 and 13 mm with a slope no greater than 1:2.

2.9 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer or per JIS A 5536 and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

2.10 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Use one of the following substrates:

[ a. Particleboard: As specified in Section 06 10 00 ROUGH CARPENTRY.]
[ b. Fiberboard: As specified in Section 06 10 00 ROUGH CARPENTRY.]
[ c. Cork: As specified in Section 06 10 00 ROUGH CARPENTRY.]
[ d. Cement-fiber board: As specified in Section 09 29 00 GYPSUM BOARD.]
[ e. Plywood: As specified in Section 06 10 00 ROUGH CARPENTRY.]
[ f. Concrete.]

2.11 POLISH/FINISH

Provide polish finish as recommended by the manufacturer.

2.12 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.13 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories [selected from manufacturer's standard colors] [[____]]. Color listed is not intended to limit the selection of equal colors from other manufacturers.[ Provide floor patterns as specified on the [drawings Sheet No. [____]] [____].] Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions.
Submit manufacturer's descriptive data and [three] [_____] samples of each indicated color and type of flooring, base, mouldings, and accessories sized a minimum 60 by 100 mm. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

2.14 FIRE RESISTANCE TESTING REQUIREMENTS

Provide a minimum average critical radiant flux of [0.22][0.45] watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E648.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 4.75 in 3048 mm. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 GENERAL INSTALLATION

Do not install building construction materials that show visual evidence of biological growth. Installation shall comply with MLIT SS Chapter 19.
3.5 PLACING VINYL COMPOSITION, LINOLEUM AND SOLID VINYL TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.6 PLACING LUXURY VINYL TILES

[Install luxury vinyl tile flooring using [glue down] [loose lay (room perimeter adhesive only)] installation.] Install flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions for installation method specified. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.7 PLACING SHEET VINYL FLOORING

Install sheet vinyl flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. [Provide [chemically bonded] [or] [heat welded] seams and edges [in rooms [_____]]] [shown on the drawings] in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas. [Install flooring with an integral coved base.]

3.8 PLACING SHEET LINOLEUM FLOORING

Install sheet linoleum flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Cut seams by overlapping or underscribing as recommended by the manufacturer. [Provide heat welded seams [in rooms [_____]]] [as shown on the drawings] in accordance with the manufacturer's written installation instructions.] Finish joints flush, free from voids, recesses, and raised
areas. [Install flooring with an integral coved base.]

3.9 PLACING CORK FLOORING

Install cork [tile] [plank flooring] and accessories in accordance with manufacturer's installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Provide square, symmetrical, tight, and even flooring lines and joints except where slope is indicated. Keep each floor in true, level plane, except where slope is indicated. [Vary width of edge tiles as necessary to maintain full-size tiles in field, while keeping edge tiles larger than one-half full size, except where irregular-shaped rooms make it impossible.] Cut and fit flooring around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit and scribe flooring to walls and partitions after field flooring has been applied.

3.10 PLACING FEATURE STRIPS

Install feature strips in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.11 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. [Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.] [Anchor aluminum moulding to floor surfaces as recommended by the manufacturer.]

3.12 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.13 PLACING STAIR TREADS, RISERS, AND STRINGERS

Secure and install stair treads, risers, and stringers in accordance with manufacturer's printed installation instructions. Cover the surface of treads and risers[ the full width of the stairs][ within 150 mm to the stair edges]. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths. [Provide stringer angles on both the wall and banister sides of the stairs, and landing trim.]

3.14 PLACING INTEGRAL COVED BASE

Install integral cove base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Shape integral coved base by extending the flooring material [100] [150] [_____] mm onto the wall surface. Support cove by a filler. Provide a cap strip at the top of the base.
Fill voids along the top edge of base at masonry walls with caulk.

3.15 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and finish in accordance with manufacturer's written instructions.

3.16 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

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11/17

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PART 1   GENERAL

1.1    REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1125 (2015) Methods Of Test For Moisture Content Of Aggregate And Surface Moisture In Aggregate By Drying


JIS A 5536 (2015) Adhesives for Resilient Textile or Laminate Floor Coverings


JIS L 0805 (2005) Gray Scale for Assessing Staining

JIS L 0849 (2013) Test Methods for color fastness to rubbing

1.2 SUBMITTALS

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SD-02 Shop Drawings
Installation Drawings; G[, [______]]

SD-10 Operation and Maintenance Data
Cleaning and Protection
Maintenance Service

SD-11 Closeout Submittals
Warranty

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

1.3.1.1 Floor Covering Materials

Provide products certified to meet indoor air quality requirements by
providing the certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 16 degrees C for 2 days prior to installation. Do not store carpet or carpet tiles with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants, including paints and adhesives. Do not store carpet near materials that may off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 AMBIENT CONDITIONS

Maintain areas in which carpeting is to be installed at a temperature above 16 degrees C and below 32 degrees C for 2 days before installation, during installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 13 degrees C thereafter for the duration of the contract.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten year wear warranty, two year material and workmanship and ten year tuft bind and delamination.

PART 2 PRODUCTS

2.1 CARPET

Furnish first quality carpet that is free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Provide carpet materials and treatments as reasonably nonallergenic and free of other recognized health hazards. Provide a static control construction on all grade carpets which gives adequate durability and performance. Submit manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory. Submit manufacturer's Product Data for 1) Carpet, 2) Moldings, and 3) Carpet Cushion. Also, submit Samples of the following:

a. Carpet: [Two] [_____] "Production Quality" samples 450 by 450 mm of each carpet proposed for use, showing quality, pattern, and color specified

b. Moldings: [Two] [_____] samples of each type minimum 300 mm long

c. Carpet Cushion: [Two] [_____] samples minimum 150 by 150 mm
2.1.1  Physical Characteristics for [Broadloom] [Modular Tile] [Entrance] Carpet

2.1.1.1  Carpet Construction

[Tufted] [Woven] [Bonded] [Needlebond] [Needle Felt] [_____]

2.1.1.2  Type

[Broadloom [3.6] [1.8] m minimum usable carpet width [with exception of corridors] [and] [stairs] [_____].] [Modular tile [450 by 450] [500 by 500] [600 by 600] [914 by 305] [1219 by 305] [_____] mm square with 0.15 percent growth/shrink rate in accordance with ISO 2551 or JIS L 1021-10.] [Entrance [450 by 450] [_____] mm square [3.6] [1.8] m width [_____] mat size.]

2.1.1.3  Pile Type

[Level-loop] [Multilevel loop] [Cut and loop] [Frieze] [Cut pile] [Random sheared] [Level tip shear]

2.1.1.4  Pile Fiber

Commercial 100 percent branded (federally registered trademark) [nylon continuous filament] [nylon staple].

2.1.1.5  Gauge or Pitch

Minimum [_____] mm in accordance with JIS L 1021-5.

2.1.1.6  Stitches or Rows/Wires

Minimum [_____] per square meter

2.1.1.7  Surface Pile Weight

Minimum [_____] kg/square meter. This does not include weight of backings. Determine weight in accordance with JIS L 1021-4.

2.1.1.8  Pile Thickness

Minimum [_____] mm in accordance with JIS L 1021-3.

2.1.1.9  Pile Density

Minimum [_____]

2.1.1.10  Dye Method

[Solution dyed] [Stock dyed] [Yarn (or Skein) dyed] [Piece dyed] [Space dyed] [Continuous dyed]

2.1.1.11  Backing Materials

Provide primary backing materials like [those customarily used and accepted by the trade for each type of carpet] [polypropylene] [synthetic material] [rubber] [jute] [cotton] [_____]. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.
2.1.1.12 Attached Cushion

Provide an attached cushion [chemically frothed polyurethane with minimum weight of 0.610 kg/sq. m, minimum density of 176 kg/cubic m] [mechanically frothed polyurethane with minimum weight of 0.745 kg/sq. m, minimum density of 224 kg/cubic m, minimum thickness of 2.5 mm, and maximum compression resistance of 34.5 kPa, and compression set of 15 percent in accordance with JIS K 7134]. Do not exceed the maximum ash content of 50 percent. Pass the accelerated aging test in accordance with [JIS K 7134] for the cushion.

2.2 PERFORMANCE REQUIREMENTS

2.2.1 Texture Appearance Retention Rating (TARR)

Provide carpet with a greater than or equal to [3.0 (Heavy)] [3.5 (Severe)] TARR traffic level classification in accordance with JIS L 1021-13.

2.2.2 Static Control

Provide static control to permanently regulate static buildup to less than [3.5] [2.0] [_____] kV when tested at 20 percent relative humidity and 21 degrees C in accordance with JIS L 4406.

2.2.3 Flammability and Critical Radiant Flux Requirements

Comply with ASTM E648. Provide carpet in corridors and exits with a minimum average critical radiant flux of [0.22] [0.45] watts per square centimeter when tested in accordance with ASTM E648. Flame time earlier than 20 seconds, burned yarn shorter than 10 mm in accordance with JIS L 4406. Carpet shall be flameproof in accordance with Japan Fire Defense Law and prescribed in Fire Service Act (Act No. 186 of 1948).

2.2.4 Tuft Bind

Comply with JIS L 4405 for tuft bind force required to pull a tuft or loop free from carpet backing with a minimum [40 N average force for loop pile broadloom] [18 N average force for cut pile broadloom] [36 N average force for modular carpet tile]. Provide tuft bind force required to pull a tuft or loop free from carpet backing with a minimum 24.5 N average force for loop pile in accordance with JIS L 4406.

2.2.5 Colorfastness to Crocking

Comply dry and wet crocking with JIS L 0849 for all colors.

2.2.6 Colorfastness to Light

Comply colorfastness to light with JIS L 0805/ JIS L 4406.

2.2.7 Colorfastness to Water

Comply colorfastness to water with JIS L 1021-10 and with a minimum 4.0 gray scale rating and a minimum 4.0 transfer scale rating.

2.2.8 Delamination Strength

Provide delamination strength for tufted carpet with a secondary back of minimum 440 N/m.
2.2.9 Antimicrobial

Nontoxic antimicrobial treatment in accordance with JIS L 1902 guaranteed by the carpet manufacturer to last the life of the carpet.

2.3 CARPET CUSHION

[2.3.1 Fiber Cushion

[Rubberized hair, mothproofed and sterilized] [Rubberized jute [with minimum 40 percent recycled content], mothproofed and sterilized]
[Synthetic with minimum [___] percent recycled content] [Resinated, recycled textile].

2.3.1.1 Weight

[___] g/sq.m

2.3.1.2 Thickness

[___] mm plus 5 percent maximum

2.3.1.3 Density

[___] kg/cu.m

][2.3.2 Rubber Cushion

[Flat] [Rippled waffle] [Textured flat] [Reinforced] [, with minimum 60 percent recycled content.]

2.3.2.1 Weight

[___] g/sq.m

2.3.2.2 Thickness

[___] mm plus 5 percent maximum

2.3.2.3 Density

[___] kg/cu.m

][2.3.3 Polyurethane-Foam Cushion

[Grafted prime] [Densified] [Bonded] [Mechanically frothed] [, with minimum 15 percent recycled content].

2.3.3.1 Thickness

[___] mm plus 5 percent maximum

2.3.3.2 Density

[___] kg/cu.m
2.3.4 Performance Requirements - Critical Radiant Flux

Provide carpet cushion in corridors and exits with a minimum average critical radiant flux of [0.22][0.45] watts per square centimeter when tested in accordance with ASTM E648.

2.4 ADHESIVES AND CONCRETE PRIMER

Comply with applicable regulations regarding toxic and hazardous materials. Provide water resistant, mildew resistant, nonflammable, and nonstaining adhesives and concrete primers for carpet installation as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 60 degrees C in accordance with JIS K 2265-1. Non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of JIS A 1901-1 (limit requirements for either office or classroom spaces regardless of space type). Aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of JIS A 1901-1 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of JIS A 5536. Concrete primer products used on the interior of the building (defined as inside of the weatherproofing system) must meet either emissions requirements of JIS A 1901-1 (limit requirements for either office or classroom spaces regardless of space type).

2.5 MOLDINGS

Provide carpet moldings where floor covering material changes or carpet edge does not abut a vertical surface. Provide [a heavy-duty [vinyl] [rubber] molding designed for the type of carpet being installed. Provide floor flange of a minimum [38 mm] wide. Provide color to match [resilient base] [_____.] [an aluminum molding, pinless clamp-down type, designed for the type of carpet being installed. Provide [natural color anodized] [prefinished color [_____] finish. Provide a floor flange of a minimum 38 mm wide and face a minimum 16 mm wide.]

2.6 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in broadloom installation. Seam sealant must have a maximum VOC content of no more than 50 grams/liter. Do not use sealants that contain 1,1,1-trichloroethane or toluene.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with this section or as indicated on the drawings.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep
clean. Before beginning work, test subfloor with glue and carpet to
determine "open time" and bond. Submit [three] [_____] copies of the
manufacturer's printed Installation instructions for the carpet, including
Surface Preparation, seaming techniques, and recommended adhesives and
tapes.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content in accordance with JIS A 1125.
Conform to manufacturer recommendations for pH level and alkalinity of the
concrete substrate. Submit [three] [_____] copies of reports of Moisture
and Alkalinity Tests including content of concrete slab stating date of
test, person conducting the test, and the area tested.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting until concrete substrate is
at least 90 days old. Prepare the concrete surfaces in accordance with the
carpet manufacturer's instructions. Match carpet, when required, and
adhesives to prevent off-gassing to a type of curing compounds, leveling
agents, and concrete sealer.

3.4 INSTALLATION

Installation shall comply with MLIT SS Chapter 19. Isolate area of
installation from rest of building. Perform all work by manufacturer's
approved installers. Conduct installation in accordance with the
manufacturer's printed instructions. Protect edges of carpet meeting hard
surface flooring with molding and install in accordance with the molding
manufacturer's printed instructions. Use autofoam mothproofing system for
wool carpets. Follow ventilation, personal protection, and other safety
precautions recommended by the adhesive manufacturer. Continue ventilation
during installation and for at least 72 hours following installation. Do
not permit traffic or movement of furniture or equipment in carpeted area
for 24 hours after installation. Complete other work which would damage
the carpet prior to installation of carpet. Submit [three] [_____] copies
of Installation Drawings for 1) Carpet, 2) Carpet Cushion, and 3) Moldings
indicating areas receiving carpet, carpet types, patterns, direction of
pile, location of seams, and locations of edge molding.

Do not install building construction materials that show visual evidence of
biological growth.

3.4.1 Broadloom Installation

Install broadloom carpet [direct glue down] [pre-applied adhesive glue
down] smooth, uniform, and secure, with a minimum of seams. Apply regular,
unnoticeable, and treated seams with a seam adhesive. Run side seams
toward the light, where practical, and where such layout does not increase
the number of seams. Install breadths parallel, with carpet pile in the
same direction. Match patterns accurately. Neatly cut and fit cutouts, at
door jambs, columns and ducts securely. Locate seams at doorways parallel
to and centered directly under doors. Do not make seams perpendicular to
doors or at pivot points. Provide seams at changes in directions of
corridors to follow the wall line parallel to the carpet direction. Lay
the carpet lengthwise down the corridors with widths less than 1.8 m.
3.4.2 Modular Tile Installation

Install modular tiles with [releasable] [manufacturer approved adhesive tab system] [permanent vinyl-compatible] [_____] adhesive and snug joints. Use [monolithic] [1/4 turn] [ashlar] [brick] [herringbone] [random] [_____] installation method. Comply with manufacturer installation instructions for required drying time of releasable adhesive so it sets up properly. Provide accessibility to the subfloor where required. Carpet tile on stairs and sloped surfaces must be installed with a more permanent installation method in accordance with the manufacturer's instructions and with manufacturer recommended adhesives for this application.

3.4.3 Entrance Carpet Installation

[Install tiles with [permanent vinyl-compatible] [releasable] adhesive and snug joints. Use [monolithic] [1/4 turn] [ashlar] [brick] [random] installation method.] [Install roll goods [direct glue down] [pre-applied adhesive glue down] and smooth, uniform, and secure, with a minimum of seams. Prepare regular, unnoticeable, and treated seams with a seam adhesive. Install breadths parallel, with carpet pile in the same direction. Match patterns accurately. Neatly cut and fit, securely, cutouts at door jambs, columns, and ducts. Locate seams at doorways parallel to and centered directly under doors. Do not make seams perpendicular to doors or at pivot points.] [Cut mats to specified size and finish them with a tapered vinyl edge that is glued and sewn on.]

3.4.4 Stretch-in Installation

Provide carpet tack strips wherever carpeting abuts vertical surfaces. Install tackless carpet stripping by nailing. Place carpet cushion face-up, as recommended by cushion manufacturer, over entire floor area to be carpeted with joints butted. Do not use adhesives to attach carpet, cushion, or substrate. Comply with carpet manufacturer's instructions for installation. Attach rubber or metal edge strip to substrate with adhesive for transition when carpet meets other flooring materials or to finish carpet edge when required.

3.5 CLEANING AND PROTECTION

Submit [three] [_____] copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMittALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the Contracting Officer.
3.6 REMNANTS

Manage waste as specified in the Waste Management Plan. [Provide remnants remaining from the installation, consisting of scrap pieces more than 600 mm in dimension with more than 0.6 square meters total [to the Government] [to local non-profit such as Habitat for Humanity as directed by the Government]]. [Set aside and return non-retained scraps to manufacturer for recycling into new product] [Remove non-retained scraps from site and recycle appropriately].

3.7 MAINTENANCE

3.7.1 Extra Materials

Provide extra material from same dye lot consisting of [full width continuous broadloom] [and] [uncut carpet tiles] for future maintenance. Provide a minimum of [three] [_____] percent of total square meters of each carpet type, pattern, and color. [Furnish [three] [_____] percent extra of total adhesive tabs.]

3.7.2 Maintenance Service

Collect information from the manufacturer about [maintenance agreement] [green lease] options, and submit to Contracting Officer. Service must reclaim materials for recycling and/or reuse. Service must not landfill or burn reclaimed materials. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation of manufacturer's [maintenance agreement] [take-back program] [green lease] for carpet. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and reuse.

-- End of Section --
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SECTION 09 90 00
PAINTS AND COATINGS
05/11

PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)
JIS A 5758 (2016) Sealants for Sealing and Glazing in Buildings

MASTER PAINTERS INSTITUTE (MPI)
MPI 77 (2012) Epoxy, Gloss

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

U.S. ARMY CORPS OF ENGINEERS (USACE)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.]

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings
Piping Identification
SD-08 Manufacturer's Instructions
Application Instructions
Mixing
SD-10 Operation and Maintenance Data
Coatings

1.3 CERTIFICATES

1.3.1 Indoor Air Quality
Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Paints and Coatings
Provide paint and coating products certified to meet formaldehyde emission class F****.

1.4 APPLICATOR'S QUALIFICATIONS

1.4.1 Contractor Qualification
Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on [_____] on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:
   Position or responsibility
   Employer (if other than the Contractor)
   Name of facility owner
   Mailing address, telephone number, and telex number (if non-US) of facility owner
   Name of individual in facility owner's organization who can be contacted as a reference
   Location, size and description of structure
   Dates work was carried out
   Description of work carried out on structure
1.5 QUALITY ASSURANCE

1.5.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURES. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing at no cost to the Government.

1.5.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor will provide one liter samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE of this specification.

1.5.1.2 Testing Procedure

Qualification testing of coated surfaces per MLIT SS Chapter 18 Painting Work, Table 18.1.1 and Section 18.1.7 and JIS K5600.

Testing of film thickness per JIS K5600.

1.6 REGULATORY REQUIREMENTS

1.6.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, indoor coating materials to conform to formaldehyde emission class F****. Notify Contracting Officer of any paint specified herein which fails to conform.

1.6.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.4 Asbestos Content

Provide asbestos-free materials.

1.6.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.6.6 Silica

Provide abrasive blast media containing no free crystalline silica.
1.6.7 Human Carcinogens

Provide materials that do not contain confirmed human carcinogens or suspected human carcinogens.

1.7 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 20 liters. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 4 to 35 degrees C. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to adsorb VOC emissions, [including [_____]]. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.8 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Comply with applicable local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. Include in the Activity Hazard Analysis the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of MLIT SS Chapter 18.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.

[ b. Removal and disposal of coatings which contain lead is specified in Section 02 83 00 LEAD REMEDIATION[______]. Refer to drawings for list of hazardous materials located on this project. Coordinate paint preparation activities with this specification section.

] [ c. Removal and disposal of coatings which contain asbestos materials is specified in Section 02 82 00 ASBESTOS REMEDIATION. Refer to drawings for list of hazardous materials located on this project. Coordinate paint preparation activities with this specification section.

] Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials.
1.9 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Unsuitable for drying, including when the air temperature at a location for coating is below 5 degrees C, the humidity is 85 percent or more and condensation occurs due to inadequate ventilation. Where it is not possible to avoid coating, curing measures, such as warming and ventilation, shall be performed.

b. External coatings shall generally not be performed if rain is likely to occur or during strong winds.

1.9.2 Post-Application

Vacate space for as long as possible after application. Wait a minimum of 48 hours before occupying freshly painted rooms. Maintain one of the following ventilation conditions during the curing period, or for 72 hours after application:

a. Supply 100 percent outside air 24 hours a day.

b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 13 degrees C and 29 degrees C and humidity is between 30 percent and 60 percent.

c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.10 SCHEDULING

Allow paint, polyurethane, varnish, and wood stain installations to cure prior to the installation of materials that adsorb VOCs, including [______].

1.11 COLOR SELECTION

Provide colors of finish coats as indicated or specified. Allow Contracting Officer to select colors not indicated or specified. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated. Submit color stencil codes.
1.12 LOCATION AND SURFACE TYPE TO BE PAINTED

1.12.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.12.1.1 Exterior Painting

Includes new surfaces[, existing coated surfaces,] [and] [existing uncoated surfaces,] of the building[s] and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.12.1.2 Interior Painting

Includes new surfaces[, existing uncoated surfaces,] [and] [existing coated surfaces] of the building[s] and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.12.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

[f. Do not paint surfaces in the following areas: [______].]

]1.12.3 Mechanical and Electrical Painting

Includes field coating of [interior] [and] [exterior] new [and existing] surfaces.
a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;
(2) Supports, hangers, air grilles, and registers;
(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

(1) New zinc-coated, aluminum, and copper surfaces under insulation
(2) New aluminum jacket on piping
(3) New interior ferrous piping under insulation.

1.12.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.[ In lieu of red enamel finish coat, provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals.]

b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

1.12.4 Exterior Painting of Site Work Items

Field coat the following items:

<table>
<thead>
<tr>
<th>New Surfaces</th>
<th>Existing Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>b. [_____]</td>
<td>[_____]</td>
</tr>
<tr>
<td>c. [_____]</td>
<td>[_____]</td>
</tr>
</tbody>
</table>
1.12.5 MISCELLANEOUS PAINTING

Lettering [Building ][Room Number(s) ]

Provide lettering [as scheduled on the drawings] [block] [Gothic] type, [black enamel] [water-type decalcomania, finished with a protective coating of spar varnish]. Samples must be approved before application.

1.12.6 Definitions and Abbreviations

1.12.6.1 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (such as metals, plastics, wood, paper, leather, cloth). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.12.6.2 Dry Film Thickness

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.12.6.3 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.12.6.4 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.12.6.5 Gloss Levels

<table>
<thead>
<tr>
<th>Gloss Level</th>
<th>Description</th>
<th>Units at 60 degrees</th>
<th>Units at 85 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss 30</td>
<td>Semi-Gloss</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Gloss 50</td>
<td>Semi-Gloss</td>
<td>35</td>
<td>50</td>
</tr>
<tr>
<td>Gloss 70</td>
<td>Gloss</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>Glossy</td>
<td>High-Gloss</td>
<td>70+</td>
<td>80+</td>
</tr>
</tbody>
</table>

Gloss is tested in accordance with JIS K5600. Historically, the Government has used Flat(Matte), Gloss 30(Eggshell), Gloss 50 (Semi-Gloss), and Gloss 70 (Gloss).

1.12.6.6 Paint

See Coating definition.
PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit product data sheets for specified coatings and solvents. Provide preprinted cleaning and maintenance instructions for all coating systems.

Submit Manufacturer's Instructions on Mixing: Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

Provide certification of Indoor Air Quality for paints and primers.

[Provide certification of Indoor Air Quality for consolidated latex paints.]

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, reinstall removed items by workmen skilled in the trades. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 REPUTTYING AND REGLAZING

Remove cracked, loose, and defective putty or glazing compound on glazed sash and provide new putty or glazing compound. Where defective putty or glazing compound constitutes 30 percent or more of the putty at any one light, remove the glass and putty or glazing compound and reset the glass. Remove putty or glazing compound without damaging sash or glass. Clean rabbets to bare wood or metal and prime prior to reglazing. Provide linseed oil putty for wood sash. Patch surfaces to provide smooth transition between existing and new surfaces. Finish putty or glazing compound to a neat and true bead. Allow glazing compound time to cure, in accordance with manufacturer's recommendation, prior to coating application. Allow putty to set one week prior to coating application.

3.3 RESEALING OF EXISTING EXTERIOR JOINTS

3.3.1 Surface Condition

Begin with surfaces that are clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate grooves have not been provided, clean out to a depth of 13 mm and grind to a minimum width of 6 mm without damage to adjoining work. Grinding is not required on metal surfaces.

3.3.2 Backstops

In joints more than 13 mm deep, install glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free of oil or other staining elements as recommended by sealant manufacturer. Provide backstop material compatible with sealant. Do not use oakum and other types of absorptive...
3.3.3 Primer and Bond Breaker

Install the type recommended by the sealant manufacturer.

3.3.4 Ambient Temperature

Between 4 degrees C and 35 degrees C when applying sealant.

3.3.5 Exterior Sealant

For joints, provide JIS A 5758. Color(s) will be selected by the Contracting Officer. Apply the sealant in accordance with the manufacturer's printed instructions. Force sealant into joints with sufficient pressure to fill the joints solidly. Apply sealant uniformly smooth and free of wrinkles.

3.3.6 Cleaning

Immediately remove fresh sealant from adjacent areas using a solvent recommended by the sealant manufacturer. Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean condition. Allow sealant time to cure, in accordance with manufacturer's recommendations, prior to coating.

3.4 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, [disintegrated coatings,] and other foreign matter and substances deleterious to coating performance per MLIT SS Chapter 18 for each substrate before application of paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.4.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits or per paint manufacturer's requirements. Allow surface to dry. Wipe immediately preceding the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.
d. The requirements specified are minimum. Comply also with the application instructions of MLIT SS Chapter 18 and the paint manufacturer.

e. Thoroughly clean previously painted surfaces [specified to be repainted] [damaged during construction] of all grease, dirt, dust or other foreign matter.

f. Remove blistering, cracking, flaking and peeling or otherwise deteriorated coatings.

g. Roughen slick surfaces. Repair damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls with suitable material to match adjacent undamaged areas.

h. Feather and sand smooth edges of chipped paint.

i. Clean rusty metal surfaces per MLIT SS Chapter 18 and per paint manufacturer's instructions. Use solvent, mechanical, or chemical cleaning methods to provide surfaces suitable for painting.

j. Provide new, proposed coatings that are compatible with existing coatings.

] [3.4.2 Existing Coated Surfaces with Minor Defects

[Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings.][ Remove chalking by sanding [or blasting].]

] [3.4.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

] [3.4.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

] [3.5 PREPARATION OF METAL SURFACES

3.5.1 Existing and New Ferrous Surfaces

Base surface preparation per MLIT SS Chapter 18 or per paint manufacturer's recommendations.
3.6 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.6.1 Concrete and Masonry

Base surface preparation per MLIT SS Chapter 18 or per paint manufacturer's recommendations.

a. Curing: Allow concrete, stucco and masonry surfaces to cure at least 30 days before painting, and concrete slab on grade to cure at least 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

   (1) Dirt, Chalking, Grease, and Oil: Wash new [and existing uncoated] surfaces with a solution per paint manufacturer's recommendations. Then rinse thoroughly with fresh water.[ Wash existing coated surfaces with a suitable detergent and rinse thoroughly.] For large areas, water blasting may be used.

   (2) Fungus and Mold: Wash [new][, existing coated,] [and existing uncoated] surfaces with a solution per paint manufacturer's recommendations. Rinse thoroughly with fresh water.

   (3) Paint and Loose Particles: Remove by wire brushing.

   (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a solution per paint manufacturer's recommendations.

   (5) Removal of Existing Coatings: For surfaces to receive textured coating, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.

   c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

   d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical or horizontal surfaces as determined manufacturer's recommendations. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.6.2 Gypsum Board

Base surface preparation per MLIT SS Chapter 18 or per paint manufacturer's recommendations.

a. Surface Cleaning: Verify that plaster and stucco surfaces are free from loose matter and that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp
surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by the paint manufacturer. Verify that new plaster to be coated does not exceed maximum moisture content per manufacturer's recommendations. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting or as recommended by paint manufacturer.

3.6.3 Existing Asbestos Cement Surfaces

Remove oily stains by solvent cleaning with mineral spirits, per manufacturer's recommendations. Remove loose dirt, dust, and other deleterious substances by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material. Do not wire brush or clean using other abrasive methods. Verify surfaces are dry and clean prior to application of the coating.

3.7 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.7.1 New [], Existing Uncoated, [and] [Existing Coated] Plywood and Wood Surfaces, Except Floors:

Base surface preparation per MLIT SS Chapter 18 or per paint manufacturer's recommendations.

a. Clean wood surfaces of foreign matter.

Surface Cleaning: Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution as recommended by paint manufacturer. Rinse thoroughly with fresh water.

c. Do not exceed 12 percent moisture content of the wood as measured by a moisture meter in accordance with paint manufacturer's recommendations.

d. Prime or touch up wood surfaces adjacent to surfaces to receive water-thinned paints before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

(1) Knots and Resinous Wood [and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface]: Prior to application of coating, cover knots and stains with two or more coats of 1.3-kg-cut shellac varnish, plasticized with 0.14 liters of castor oil per liter or as recommended by coating manufacturer. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the
surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

g. Prime Coat For New Exterior Surfaces: Prime coat [wood doors,] [windows,] [frames,] [and] [trim] before wood becomes dirty, warped, [or weathered].

3.7.2 Wood Floor Surfaces, Natural Finish

Base surface preparation per MLIT SS Chapter 18 or per paint manufacturer's recommendations.

a. Initial Surface Cleaning: As specified in paragraph entitled "Surface Preparation."

b. Existing Loose Boards and Shoe Molding: Before sanding, renail loose boards. Countersink nails and fill with an approved wood filler. Remove shoe molding before sanding and reinstall after completing other work. At Contractor's option, new shoe molding may be provided in lieu of reinstalling old. Provide new wood molding of the same size, wood species, and finish as the existing.

c. Sanding and Scraping: Sanding of wood floors is specified in Section [09 64 29 WOOD STRIP AND PLANK FLOORING] [09 64 23 WOOD PARQUET FLOORING] [09 64 66 WOOD ATHLETIC FLOORING] [09 64 00 PORTABLE (DEMOUNTABLE) WOOD FLOORING]. Fill floors of oak or similar open-grain wood with wood filler recommended by the finish manufacturer and the excess filler removed.

d. Final Cleaning: After sanding, sweep and vacuum floors clean. Do not walk on floors thereafter until specified sealer has been applied and is dry.

3.7.3 Interior Wood Surfaces, Stain Finish

Sand interior wood surfaces to receive stain. Fill oak and other open-grain wood to receive stain with a coat of wood filler not less than 8 hours before the application of stain; remove excess filler and sand the surface smooth. Ensuing base surface preparation per MLIT SS Chapter 18 or per paint manufacturer's recommendations.

3.7.4 Water Blasting of Existing Coated Wood Surfaces:

Provide water blasting for the following surfaces: [____].

a. Sample Panel: Prior to the initial surface cleaning, water blast a representative surface designated by the Contracting Officer. Provide surface cleaning of the remaining work to match the sample panel approved by the Contracting Officer.

b. Initial Surface Cleaning: Water blast surfaces to receive paint with a high pressure spray, to remove loose paint, dirt, and other foreign or deleterious materials. Do not flood vents or damage windows and floors. If the pressure specified will cause damage to existing wood, advise the Contracting Officer. Direct the wash nozzle at the surface at an angle of approximately 75 degrees with the surface and at a distance not greater than 1500 mm to apply water pressure required to remove loose paint, dirt, chalking, and other foreign matter.
c. Final Surface Cleaning: After allowing the surfaces to dry for a minimum of 24 hours, remove remaining dirt, splinters, loose particles, disintegrated and loose paint, grease, oil, and other foreign matter from the surface.

3.8 APPLICATION

3.8.1 Coating Application

Application of paint per MLIT SS Chapter 18. At the time of application, paint must show no signs of deterioration. Maintain uniform suspension of pigments during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Use rollers for applying paints and enamels of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Only apply paints, except water-thinned types to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Pay special attention to ensure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Apply each coat of paint so that dry film is of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Completely hide all blemishes.

Touch up damaged coatings before applying subsequent coats. [Broom clean and clear dust from interior areas before and during the application of coating material.]

[Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyl gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyl gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.]

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by
manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Cover each preceding coat or surface completely by ensuring visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: [For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing .420 mm less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.] [For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's instructions.]

3.8.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.8.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.8.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in MLIT SS Chapter 18.

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness as specified in MLIT SS Chapter 18. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.9 COATING SYSTEMS FOR METAL

Apply coatings per MLIT SS Chapter 18 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 0.038 mm DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat. Overcoat these items with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal per paint manufacturer's recommendations.

3.10 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings per MLIT SS Chapter 18 for Exterior and Interior.

3.11 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings per MLIT SS Chapter 18 for Exterior and Interior.

b. Apply stains in accordance with manufacturer's printed instructions.

[ c. Wood Floors to Receive Natural Finish: Thin first coat 2 to 1 using thinner recommended by coating manufacturer. Apply second coat not less than 2 hours and not over 24 hours after first coat has been applied. Apply with applicators as recommended by coating manufacturer. Buff or lightly sand between intermediate coats as recommended by coating manufacturer's printed instructions.

] 3.12 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide per
the following.

a. Flammable Materials: Defined as all materials known ordinarily as flammables or combustibles. AMS-STD-595, Yellow, No. 13655.

b. Toxic and Poisonous Materials: Defined as all materials extremely hazardous to life or health under normal conditions as toxics or poisons. AMS-STD-595, Brown, No. 10080.

c. Anesthetics and Harmful Materials: Defined as all materials productive of anesthetic vapors and all liquid chemicals and compound hazardous to life and property but not normally productive of dangerous quantities of fumes or vapors. AMS-STD-595, Blue, No. 15102.

d. Oxidizing Materials: Defined as all materials which readily furnish oxygen for combustion and fire producers which react explosively or with the evolution of heat in contact with many other materials. AMS-STD-595, Green, No. 14187.

e. Physically Dangerous Materials: Defined as all materials, not dangerous in themselves, which are asphyxiating in confined areas or which are generally handled in a dangerous physical state of pressure or temperature. AMS-STD-595, Gray, No. 16187.


g. Water: Piping system containing water suitable for human consumption and installed for this purpose. AMS-STD-595, White, No. 1787 or painted to match surroundings when not in conflict with other color designations.

Place stenciling in clearly visible locations. On piping not covered by the aforementioned stencil approved names or code letters, in letters a minimum of 13 mm high for piping and a minimum of 50 mm high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.13 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.14 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers.
3.15 PAINT TABLES

3.15.1 Exterior Paint Tables

DIVISION 3: EXTERIOR CONCRETE PAINT TABLE

A. [New and uncoated existing] [and Existing, previously painted] concrete; vertical surfaces, including undersides of balconies, soffits, roofs, columns and beams but excluding tops of slabs:

1. Paint system shall be formaldehyde emission class F**** minimum, Weatherproof Class 3 Type. Coatings shall comply with JIS A 6909, Multi-Layer, Type E:

   Spray Tile Finish System (4-Layer System):

   (1) Base Coat 1: Not less than 0.1 kg/sm
   (2) Texture Base Coat 1: Not less than 0.7 kg/sm
   (3) Texture Top Coat: Not less than 0.8 kg/sm
   (4) Top Coat, Acrylic, Resin, Emulsion Type, High Gloss Finish, 2 times: Not less than 0.25 kg/sm

   Primer as recommended by manufacturer. Coating system shall be applied by spray application in accordance with manufacturer's instructions.

B. [New and uncoated existing] [and Existing, previously painted] concrete, textured system; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. MLIT SS Chapter 18

   Texture - [Fine] [Medium] [Coarse]. Surface preparation and number of coats in accordance with manufacturer's instructions.

   Topcoat: Coating to match adjacent surfaces.

C. [New and uncoated existing] [and Existing, previously painted] concrete, elastomeric System; vertical surfaces, including undersides of balconies and soffits but excluding tops of slabs:

1. MLIT SS Chapter 18

   Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

D. [New and uncoated existing] [and Existing, previously painted] concrete: walls and bottom of swimming pools.

1. MLIT SS Chapter 18

E. [New] [and Existing] Cementitious composition board (including Asbestos cement board):

1. MLIT SS Chapter 18

   Topcoat: Coating to match adjacent surfaces.
DIVISION 4: EXTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. [New] [and Existing] concrete masonry on uncoated surface:
   1. MLIT SS Chapter 18
      Topcoat: Coating to match adjacent surfaces.

B. [New] [and Existing] concrete masonry, textured system; on uncoated surface:
   1. MLIT SS Chapter 18
      Texture - [Fine] [Medium] [Coarse]. Surface preparation and number of coats in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. [New] [and Existing] concrete masonry, elastomeric system; on uncoated surface:
   1. MLIT SS Chapter 18
      Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and number of coats in accordance with manufacturer's instructions.

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned or per MLIT SS Chapter 18.
   1. MLIT SS Chapter 18

B. New Steel that has been blast-cleaned:
   2. MLIT SS Chapter 18

C. Existing steel that has been spot-blasted:
   1. MLIT SS Chapter 18
   2. [Surface previously coated with epoxy: MLIT SS Chapter 18]

D. New [and existing] steel blast cleaned:
   1. MLIT SS Chapter 18
   2. [Pigmented Polyurethane MLIT SS Chapter 18]

E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations:
   1. MLIT SS Chapter 18

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EXTERIOR GALVANIZED SURFACES

F. New Galvanized surfaces:

1. MLIT SS Chapter 18

2. [Waterborne Primer / Latex
   MLIT SS Chapter 18]

3. [Waterborne Primer / Waterborne Light Industrial Coating
   MLIT SS Chapter 18
   System DFT: 112 microns]

4. [Epoxy Primer / Waterborne Light Industrial Coating
   MLIT SS Chapter 18]

5. [Pigmented Polyurethane
   MLIT SS Chapter 18]

G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. MLIT SS Chapter 18

2. [Pigmented Polyurethane
   MLIT SS Chapter 18]

H. Galvanized surfaces with severely deteriorated coating or rusting:

1. MLIT SS Chapter 18

2. [Pigmented Polyurethane
   MLIT SS Chapter 18]

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. [Alkyd
   MLIT SS Chapter 18]

2. [Waterborne Light Industrial Coating
   MLIT SS Chapter 18]

J. Existing roof surfaces previously coated:

1. MLIT SS Chapter 18

2. [Aluminum Paint
   MLIT SS Chapter 18]

K. Surfaces adjacent to painted surfaces; [Mechanical,] [Electrical,] [Fire extinguishing sprinkler systems including valves, conduit, hangers, supports,] [exposed copper piping,] [and miscellaneous metal items] not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:
1. [Alkyd
MLIT SS Chapter 18]

2. [Waterborne Light Industrial Coating
MLIT SS Chapter 18]

3. 15.2 Interior Paint Tables

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. [New and uncoated existing] [and Existing, previously painted] Concrete, vertical surfaces, not specified otherwise:

1. MLIT SS Chapter 18

2. [High Performance Architectural Latex
MLIT SS Chapter 18]

3. [Institutional Low Odor / Low VOC Latex
MLIT SS Chapter 18]

B. Concrete ceilings, uncoated:

1. [Latex Aggregate
MLIT SS Chapter 18]

Texture - [Fine] [Medium] [Coarse]. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.

C. [New and uncoated existing][ and ] [Existing, previously painted] Concrete in [toilets,] [food-preparation,] [food-serving,] [restrooms,] [laundry areas,] [shower areas,] [areas requiring a high degree of sanitation,]
[_____] [and other high-humidity areas] not otherwise specified except floors:

1. Coating shall conform to JIS K5670, 0.10 kg/sm for base coat and JIS K5670, 0.10 kg/sm for top coat.

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New [and uncoated Existing] Concrete masonry:

1. [High Performance Architectural Latex
MLIT SS Chapter 18]

Fill all holes in masonry surface]

2. [Institutional Low Odor / Low VOC Latex
MLIT SS Chapter 18]

B. Existing, previously painted Concrete masonry:

1. [High Performance Architectural Latex
MLIT SS Chapter 18]

2. [Institutional Low Odor / Low VOC Latex
MLIT SS Chapter 18]
C. New [and uncoated Existing] Concrete masonry units in [toilets,]
   [food-preparation,] [food-serving,] [restrooms,] [laundry areas,] [shower
   areas,] [areas requiring a high degree of sanitation,] [____,] [and
   other high humidity areas] unless otherwise specified:

1. [Waterborne Light Industrial Coating
   MLIT SS Chapter 18
   Fill all holes in masonry surface]

2. [Alkyd
   MLIT SS Chapter 18
   Fill all holes in masonry surface]

3. [Epoxy
   MLIT SS Chapter 18
   Fill all holes in masonry surface]

D. Existing, previously painted, concrete masonry units in [toilets,]
   [food-preparation,] [food-serving,] [restrooms,] [laundry areas,] [shower
   areas,] [areas requiring a high degree of sanitation,] [____,] [and
   other high humidity areas] unless otherwise specified:

1. [Waterborne Light Industrial Coating
   MLIT SS Chapter 18]

2. [Alkyd
   MLIT SS Chapter 18]

3. [Epoxy
   MLIT SS Chapter 18]

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, [Mechanical,] [Electrical,] [Fire extinguishing sprinkler systems
   including valves, conduit, hangers, supports]. [Surfaces adjacent to
   painted surfaces (Match surrounding finish),] [exposed copper piping,]
   [and miscellaneous metal items] not otherwise specified except floors,
   hot metal surfaces, and new prefinished equipment:

1. [High Performance Architectural Latex
   MLIT SS Chapter 18]

2. [Alkyd
   MLIT SS Chapter 18]

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with
   non-skid additive (NSA), load at manufacturer's recommendations.:

1. [Alkyd Floor Paint
   MLIT SS Chapter 18]

2. [Epoxy
   MLIT SS Chapter 18]

C. Metal in [toilets,] [food-preparation,] [food-serving,] [restrooms,
[laundry areas,] [shower areas,] [areas requiring a high degree of sanitation,] [_____,] [and other high-humidity areas] not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. [Alkyd MLIT SS Chapter 18]

2. [Alkyd MLIT SS Chapter 18]

D. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. [High Performance Architectural Latex MLIT SS Chapter 18]

2. [Alkyd MLIT SS Chapter 18]

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New [and Existing, uncoated] Wood and plywood not otherwise specified:

1. [High Performance Architectural Latex MLIT SS Chapter 18]

2. [Alkyd MLIT SS Chapter 18]

3. [Institutional Low Odor / Low VOC Latex New; MPI INT 6.3V-G2 (Flat) MLIT SS Chapter 18]

B. Existing, previously painted Wood and plywood not otherwise specified:

1. [High Performance Architectural Latex MLIT SS Chapter 18]

2. [Alkyd MLIT SS Chapter 18]

3. [Institutional Low Odor / Low VOC Latex MLIT SS Chapter 18]

C. New [and Existing, previously finished or stained] Wood and Plywood, except floors; natural finish or stained:

1. [Natural finish, oil-modified polyurethane MLIT SS Chapter 18]

2. [Stained, oil-modified polyurethane MLIT SS Chapter 18]

3. [Stained, Moisture Cured Urethane MLIT SS Chapter 18]
D. New [and Existing, previously finished or stained] Wood Floors; Natural finish or stained:

1. [Natural finish, oil-modified polyurethane
   MLIT SS Chapter 18]

2. [Natural finish, Moisture Cured Polyurethane
   MLIT SS Chapter 18]

3. [Stained, oil-modified polyurethane
   MLIT SS Chapter 18]

4. [Stained, Moisture Cured Polyurethane
   MLIT SS Chapter 18]

E. New [and Existing, previously coated] Wood floors; pigmented finish:

1. [Latex Floor Paint
   MLIT SS Chapter 18]

2. [Alkyd Floor Paint
   MLIT SS Chapter 18]

F. New [and Existing, uncoated] wood surfaces in [toilets,]
   [food-preparation,] [food-serving,] [restrooms,] [laundry areas,] [shower areas,] [areas requiring a high degree of sanitation,] [_____] [and other high humidity areas] not otherwise specified:

1. [As specified in Section 09 96 59 HIGH-BUILD GLAZE COATINGS.]

2. [MLIT SS Chapter 18]

3. [Alkyd
   MLIT SS Chapter 18]

G. Existing, previously painted wood surfaces in [toilets,]
   [food-preparation,] [food-serving,] [restrooms,] [laundry areas,] [shower areas,] [areas requiring a high degree of sanitation,] [_____] [and other high humidity areas] not otherwise specified:

1. [As specified in Section 09 96 59 HIGH-BUILD GLAZE COATINGS.]

2. [MLIT SS Chapter 18]

3. [Alkyd
   MLIT SS Chapter 18]

H. New [and Existing, previously finished or stained] Wood Doors; Natural Finish or Stained:

1. [MLIT SS Chapter 18]
   Note:  Sand between all coats per manufacturers recommendations.

2. [Stained, oil-modified polyurethane
   MLIT SS Chapter 18]
   Note:  Sand between all coats per manufacturers recommendations.

3. [Stained, Moisture Cured Urethane
   MLIT SS Chapter 18]
Note: Sand between all coats per manufacturers recommendations.

I. New [and Existing, uncoated] Wood Doors; Pigmented finish:

1. [Alkyd
   MLIT SS Chapter 18]
   Note: Sand between all coats per manufacturers recommendations.

2. [Pigmented Polyurethane
   MLIT SS Chapter 18]
   Note: Sand between all coats per manufacturers recommendations.

J. Existing, previously painted Wood Doors; Pigmented finish:

1. [Alkyd
   MLIT SS Chapter 18]
   Note: Sand between all coats per manufacturers recommendations.

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New [and Existing, previously painted] [Plaster] [and] [Wallboard] not otherwise specified:

1. [Latex
   MLIT SS Chapter 18]

2. [High Performance Architectural Latex - High Traffic Areas
   MLIT SS Chapter 18]

3. [Institutional Low Odor / Low VOC Latex
   MLIT SS Chapter 18]

B. New [and Existing, previously painted] [Plaster] [and] [Wallboard] in [toilets,] [food-preparation,] [food-serving,] [restrooms,] [laundry areas,] [shower areas,] [areas requiring a high degree of sanitation,] [_____] [and other high humidity areas] not otherwise specified:

1. [Waterborne Light Industrial Coating
   MLIT SS Chapter 18]

2. [Alkyd
   MLIT SS Chapter 18]

3. [Epoxy
   MLIT SS Chapter 18]

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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS G 3101  (2017) Rolled Steels for General Structure (Amendment 1)
JIS G 3302  (2019) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 3466  (2015) Carbon Steel Square and Rectangular Tubes for General Structure
JIS H 4000  (2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)
JIS H 5202  (2010) Aluminum Alloy Castings
JIS H 8641  (2007) Hot Dip Galvanized Coatings
JIS K 5906  (1998) Aluminum Pigments For Paints
JIS K 6735  (2014) Plastics - Polycarbonate sheets - Types, dimensions and characteristics
JIS R 3205  (2005) Laminated Glass
JIS Z 3410  (2013) Welding Coordination - Tasks and Responsibilities
1.2 GENERAL REQUIREMENTS

All exterior signage must be provided by a single manufacturer. Exterior signage must be of the design, detail, sizes, types, and message content shown on the drawings, must conform to the requirements specified, and must be provided at the locations indicated. Submit exterior signage schedule in electronic media with spread sheet format. Spread sheet must include sign location, sign type, and message. Signs must be complete with lettering, framing as detailed, and related components for a complete installation. Each sample must consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit [three] color samples for each material requiring color and 300 mm square sample of sign face color sample.

1.2.1 Wind Load Requirements

Exterior signage must be designed to withstand [_____] km/h windload. Submit design analysis and supporting calculations performed in support of specified signage.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings must have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs must be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings
   Approved Detail Drawings; G[, [_____]]
SD-10 Operation and Maintenance Data
   Protection and Cleaning; G[, [_____]]

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment must essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials must be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period must be provided.

1.7 EXTRA STOCK

Provide [_____] extra interchangeable message panels and extra stock of the following: [_____] message bars of each color and size for sign types [______]. [_____] pressure-sensitive letters in each color and size for sign type [______]. [_____] changeable message strips for sign type [______].

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage must consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage must be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs

2.1.1.1 Framing

Interior framing must consist of [aluminum] [or] [galvanized steel] tube columns welded to companion plates. Perimeter framing must consist of [aluminum] [or] [steel] angle framing welded to the post and plate system as designed. Framing members must be designed to permit [access to electrical equipment] [and] [panel removal]. Mounting must be provided as shown. Framing members of steel must be finished with semi-gloss baked enamel or two-component acrylic polyurethane. Openings must be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels must be provided in sizes shown on drawings. Panels must be
fabricated a minimum of [3 mm thick [aluminum] [steel]] [3 mm thick fiberglass reinforced plastic (FRP)]. [Panels must be heliarc welded to framing system [______].] Top and end panels must be removable and must be secured by 5 mm socket head jack nuts. Finish for metal panels must be [semi-gloss baked enamel] [two-component acrylic polyurethane] [anodized conforming to JIS H 8602].

2.1.1.3 Mounting
Mount by securing to concrete foundation as indicated.

2.1.1.4 Finishes
Base finish must be [semi-gloss baked enamel] [or] [two-component acrylic polyurethane] [anodized conforming to JIS H 8602] [______]. Metal panel system finish must be [baked enamel or two-component acrylic polyurethane] [anodized conforming to JIS H 8602] [______], as shown.

2.1.2 Panel And Post/Panel Type Signs

2.1.2.1 Posts
One-piece [aluminum] [or] [galvanized steel] posts must be provided with minimum 3.2 mm wall thickness. Posts must be designed to accept panel framing system described. The post must be designed to permit attachment of panel framing system without exposed fasteners. Caps must be provided for each post.

2.1.2.2 Panel Framing System
Panel framing consisting of aluminum sections and interlocking track components must be designed to interlock with posts with concealed fasteners.

2.1.2.3 Panels
Modular message panels must be provided in sizes shown on drawings. Panels must be fabricated a minimum of [3 mm aluminum] [3 mm acrylic] [3 mm fiberglass reinforced plastic (FRP)]. [Panels must be designed to be interchangeable.] [Panels with metal return sheeting must have welded corners, ground smooth.] [Panels must be heliarc welded to framing system.] [Face panels must be removable to provide access to electrical components.]

2.1.2.4 Finishes
Post finish must be [semi-gloss baked enamel] [or] [two-component acrylic polyurethane] [anodized conforming to JIS H 8602] [______]. Metal panel system finish must be [baked enamel or two-component acrylic polyurethane] [anodized conforming to JIS H 8602] [______], as shown.

2.1.2.5 Mounting
[Provide permanent mounting by embedding posts in concrete foundation as indicated.] [Provide removable mounting by [[a steel] [an aluminum]] [[sleeve] [flange]] embedded in concrete as indicated.]
2.1.3 Changeable Letter Directories

2.1.3.1 Frame and Trim

Aluminum alloy finish must be [______].

2.1.3.2 Header Plates

[Header plate must consist of background metal matching frame and having raised letters attached through the back.]  [Header plate must consist of acrylic with raised acrylic letters.]  [Header plate must consist of MP plastic with raised letters.]

2.1.3.3 Door Glazing

Door glazing must be [clear safety or tempered glass minimum 6 mm thick.] [clear acrylic sheet 5 mm thick.] [clear polycarbonate sheet [5] [6] mm thick.]

2.1.3.4 Door Construction

Door frame must be of same material and finish as surrounding frame. Corners must be mitered [, reinforced] [, welded], and assembled with concealed fasteners. Hinges must be standard with manufacturer, in finish to match frames and trim. Glazing must be set in frame with resilient glazing channels.

2.1.3.5 Door Locks

Door locks must be manufacturer's standard and must be keyed alike.

2.1.3.6 Fabrication

Frames and trim must be assembled with corners [reinforced] [welded] and mitered to hairline fit, with no exposed fasteners. Removable changeable directory panel must consist of [6 mm thick white acrylic with clear acrylic letter tracks] [exterior grade plywood] [aluminum] [rubber] back with [vinyl] [polycarbonate] [corkboard] covering backgrooved 6 mm on centers to receive letters.

2.1.3.7 Finishes

Post finish must be [semi-gloss baked enamel] [or] [two-component acrylic polyurethane] [anodized conforming to JIS H 8602] [______]. Metal panel system finish must be [baked enamel or two-component acrylic polyurethane] [anodized conforming to JIS H 8602 [______], as shown].

2.1.3.8 Mounting

Directories must be mounted to supporting structures with concealed fasteners in accordance with manufacturer's instructions.

2.1.3.9 Changeable Letters

Changeable letters must be upper-case or upper and lower-case [helvetica medium] [______]. Tabbed vinyl letters and numbers must be furnished in accordance with the [drawings] [and] [schedule].
2.2 ILLUMINATION

Concealed lighting must be provided within panel framing members. Lighting must be controlled by a photocell device. [Top] [Back] lighting and electrical equipment must be provided by UL or FM listed and comply with NFPA 70. Illumination must be evenly distributed. A switch on the interior of the sign must be provided to turn off power in the sign. Switch must be readily accessible when sign is open.

2.3 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.3.1 Graphics

Signage graphics must conform to the following:

[ a. [Cast] [Custom fabricated] [Plate] aluminum letters, [6] [13] [_____] mm thick must be provided and fastened to the message panel with concealed fasteners. Letters must project [_____] mm from face of panel.]

[ b. Pressure sensitive precision cut vinyl letters [with reflecting surface] [_____] must be provided.]

[ c. Message must be applied to panel using the silkscreen process. Silkscreened images must be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art must be defined as artwork that is a first generation pattern of the original specified art. Edges and corners must be clean. Rounded corners, cut or ragged edges, edge buildup, bleeding or surfaces pinholes will not be accepted.]

[ d. Message letters must be cut out from panel. Panel cutouts must be backed with [2.0 mm FRP] [3.2 mm acrylic] where cutouts occur.]

[ e. Message must be cut out from panel. Acrylic letters [3] [6] [13] mm thick must be projected through the cutout area and chemically welded to 3.2 mm thick acrylic backup sheet.]

[ f. Message must be embedded in FRP sheet and completely covered with thermosetting polyester resin. Message must be embedded minimum 1 mm. Sheets must be processed in one piece, in one process, to prevent delamination.]

[ g. Message must be applied using the frisket method. Photomechanically reproduced graphic masks must be applied to the sign face which has been coated with the graphics color. A background must then be applied to the exposed surfaces. Handcut masks will not be accepted. Edges that are nicked, cut, or ragged will not be acceptable. A protective overcoat containing UV-resistant additives must be applied.]

[ h. Message must be engraved in non-corrosive, three-ply fiberglass laminate. Message must be core color or paint filled multiple colors.]

2.3.2 Messages

See [drawings] [and] [schedule] for message content. Typeface: [Helvetica medium] [______]. Type size [_____] [as indicated].
2.4 METAL PLAQUES

   Design and location of plaques must be as indicated.

2.4.1 Cast Metal Plaques

2.4.1.1 Fabrication

   Cast metal plaques must have the logo, emblem and artwork cast in the [bas relief] [flat relief] [_____] technique. Plaques must be fabricated from [prime aluminum] [bronze] [yellow brass].

2.4.1.2 Size

   Plaque size must be [_____] [as indicated].

2.4.1.3 Border

   Border must be [flat band] [plain edge] [bevel] [custom ornamental as indicated] [_____].

2.4.1.4 Background

   Background texture must be [leather] [fine pebble] [_____].

2.4.1.5 Mounting

   Mounting must be [concealed] [rosettes and anchors] [rosettes and toggle bolts] [invisible] [_____].

2.4.1.6 Finish

   Finishes must consist of [aluminum light colored sandblasted background. Letters must be satin polished and entire plaque must be sprayed with two coats of clear lacquer.] [aluminum with background sprayed dark gunmetal colored lacquer. Letters must be satin polished and entire plaque sprayed with two coats clear lacquer.] [bronze with dark finish oxidized background. Letters must be satin polished and entire plaque sprayed with two coats of clear lacquer.] [aluminum] [bronze] with sprayed background. Letters must be satin polished.]

2.4.2 Chemically Etched Metal Plaques

2.4.2.1 Fabrication

   Plaque must be chemically [single-] [double-] etched one-piece [brass] [bronze] [_____] mm thick.

2.4.2.2 Size

   Plaque size must be [_____] [as shown].

2.4.2.3 Finish

   [Single-etched raised areas must be in [gold-tone] [silver-tone] [bronze-tone] finish and recessed areas must be colorfilled.] [Double-etched raised areas must be [gold-tone] [silver-tone] and recessed textured areas must be [gold-tone] [silver-tone] colorfilled.]
2.4.3  Frost and Surface Oxidized Plaques

2.4.3.1  Fabrication

Plaque must be frosted and surface oxidized one - piece [anodized aluminum] [brass] [bronze] [stainless steel] [_____] mm thick.

2.4.3.2  Size

Plaque size must be [_____] [as shown].

2.4.3.3  Finish

[Material finish must be [satin] [polished].] [Frosted areas must be oxidized [black for aluminum or stainless steel] [or] [black or brown, for brass or bronze].]

2.5  DIMENSIONAL BUILDING LETTERS

2.5.1  Fabrication

Letters must be fabricated from [cast aluminum] [cast bronze] [2 mm aluminum sheet] [3 mm aluminum sheet] [extruded aluminum] [_____]. Letters must be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters must be packaged for protection until installation.

2.5.2  Typeface

Typeface must be [helvetica medium] [_____] [as indicated].

2.5.3  Size

Letter size must be [_____] [as indicated].

2.5.4  Finish

[Anodized aluminum] [Baked enamel or two-component acrylic polyurethane] [[Polished] [Oxidized] bronze with clear coat] finish must be provided.

2.5.5  Mounting

[Threaded studs] [Steel U-bracket, cap screws, and expansion bolts] of number and size as recommended by manufacturer, must be used for concealed anchorage. Letters which project from the building line must have stud spacer sleeves. Letters, studs, and sleeves must be of the same material. Supply templates for mounting.

2.6  ALUMINUM ALLOY PRODUCTS

Aluminum alloy products must conform to JIS H 4000 for sheet or plate, JIS H 4040 for extrusions and JIS H 5202 for castings. Aluminum extrusions must be provided at least 3 mm thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products must conform to JIS Z 3001.

2.7  ANODIC COATING

Anodized finish must conform to JIS H 8602 as follows:
Clear (natural.)

Integrated color anodized.

Electrolytically deposited color - anodized.

2.8 ORGANIC COATING

Clean, prime and give surfaces a [semi-gloss baked enamel] [or] [two-component acrylic polyurethane] finish in accordance with JIS K 5906, AMP 505, with total dry film thickness not less than 0.030 mm.

2.9 STEEL PRODUCTS

Structural steel products must conform to JIS G 3466. Sheet and strip steel products must conform to JIS G 3101. Welding for steel products must conform to JIS Z 3801.

2.10 CAST BRONZE

Fabricate components with sharp corners, flat faces, and accurate profiles. Remove and polish burrs and rough spots. Finish faces to a uniform high luster.

2.11 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting must be 5 to 7 year premium type and must be in accordance with the flammability requirements of ASTM E84 and must be a minimum 0.08 mm film thickness. Film must include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.12 ACRYLIC SHEET

Acrylic sheet must be in accordance with the flammability requirements of ASTM E84 and must conform to JIS R 3205.

2.13 POLYCARBONATE SHEET

Polycarbonate sheet must conform to JIS K 6735.

2.14 ANCHORS AND FASTENERS

Exposed anchor and fastener materials must be compatible with metal to which applied and must match in color and finish and must be non-rusting, non-corroding, and non-staining. Exposed fasteners must be tamper-proof.

2.15 SHOP FABRICATION AND MANUFACTURE

2.15.1 Factory Workmanship

Work must be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled must be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Welding to or on structural steel must be in accordance with JIS Z 3801, JIS Z 3410 and JIS Z 3841. Welding must be continuous along the entire area of contact. Exposed welds must be ground smooth. Exposed surfaces of work must have a smooth finish and exposed
riveting must be flush. Fastenings must be concealed where practical. Items specified to be galvanized must be by hot-dip process after fabrication if practical. Galvanization must be in accordance with JIS G 3302 and JIS H 8641, as applicable. Other metallic coatings of steel sheet must be in accordance with JIS G 3302. Joints exposed to the weather must be formed to exclude water. Drainage and weep holes must be included as required to prevent condensation buildup.

2.15.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces must be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.15.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, must be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete must not be painted. Upon completion of work, damaged surfaces must be recoated.

2.16 COLOR, FINISH, AND CONTRAST

Color must be [in accordance with Section 09 06 00 SCHEDULES FOR FINISHES.] [as indicated on the drawings.] [selected from manufacturers standard colors.] [______.] Color listed is not intended to limit the selection of equal colors from other manufacturers.] For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background – either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. Circuits installed underground must conform to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Steel conduits installed underground and illuminated signage mounted directly on buildings must be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs must be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces must not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials must be in accordance with approved
manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work must be protected against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering must be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit [six] [_____] copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. The instructions must include simplified diagrams for the equipment as installed. Signs must be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames must be field painted in accordance with Section 09 90 00 PAINTS AND COATINGS. Anodized metals, masonry, and glass must be protected from paint. Finish must be free of scratches or other blemishes.

-- End of Section --
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# Japan Edited Specifications

## February 2020

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### SECTION 10 14 00.20

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### 08/17

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      2.4.2.1 Door Glazing
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      2.4.2.3 Door Locks
   2.4.3 Fabrication
   2.4.4 Illuminated Units
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2.9 ANODIC COATING
2.10 ORGANIC COATING
2.11 FABRICATION AND MANUFACTURE
  2.11.1 Factory Workmanship
  2.11.2 Dissimilar Materials

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-- End of Section Table of Contents --
PART 1  GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASTM INTERNATIONAL (ASTM)


INTERNATIONAL CODE COUNCIL (ICC)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS H 4000 (2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)


JIS K 5906 (1998) Aluminum Pigments For Paints

JIS R 3202 (2011) Float Glass and Polished Plate Glass

JIS Z 3410 (2013) Welding Coordination - Tasks and Responsibilities


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2018; TIA 18-1; TIA 18-2; TIA 18-3) Life Safety Code
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G[, [_____]]

Protection and Cleaning; G[, [_____]]

1.3 EXTRA MATERIALS

Provide [_____] extra frames and extra stock of the following: [[_____] blank plates of each color and size for sign types [_____].] [[_____] changeable message strips for sign type [_____].] Provide [[_____] paper inserts and [one][_____] copy of the software for user produced signs and inserts after project completion] [and equipment necessary for removal of signage parts and pieces.]

1.4 QUALITY ASSURANCE

1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: Directional sign, Standard Room sign, Changeable message strip sign, [Facility Recognition Plaque][_____]. The samples may be installed in the work, provided each sample is identified and location recorded.

1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule
showing the location, each sign type, and message.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials must be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product must be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Warrant the interior signage for a period of [2] year[s] against defective workmanship and material. Warranties must be signed by the authorized representative of the manufacturer. Submit warranty accompanied by the document authenticating the signer as an authorized representative of the guarantor. Guarantee that the signage products and the installation are free from any defects in material and workmanship from the date of delivery.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Signs, plaques, directories, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening. Obtain signage from a single manufacturer with edges and corners of finished letterforms and graphics true and clean.

2.2 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

2.2.1 Standard Room Signs

Signs must consist of [acrylic plastic 2 mm thickness minimum conforming to ] [laminated thermosetting Type MP plastic (three-ply melamine plastic laminate with phenolic core)] [6063-T5 extruded aluminum in accordance with ] [_____] and must conform to the following:

a. Frames must be [aluminum] [wood] [molded acrylic], [flat][radius] [3 mm] [6 mm] [_____] thick.

b. End caps must be [aluminum] [wood] [molded acrylic] with [round] [square] [_____] style corners.

c. Units must be frameless. Corners of signs must be [squared] [rounded to [10] [13] [19] [_____] mm radius].

2.2.2 Changeable Message Strip Signs

Changeable message strip signs must be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert identifying changeable text. The insert must be prepared [die-cut vinyl letters applied to 0.38 mm rigid vinyl film] [typeset message mounted on paper card stock ] [typewritten message] [_____] .[ Provide paper and software for creating text and symbols for computers identified by owner for Owner production of paper inserts after project completion. ][ Furnish one [suction] [_____] device to assist in removing face sheet. ][ Sliding inserts or slide knobs that slide horizontally exposing different graphic
information must be provided as identified in the signage placement schedule and [drawings][attachments.]

2.2.3 Type of Mounting For Signs

Provide extruded aluminum brackets for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs must be by mechanical fasteners. Surface mounted signs must be mounted with [countersunk mounting holes in plaques and mounting screws][1.6 mm thick closed cell vinyl foam with adhesive backing. Adhesive must be transparent, long aging, high tech formulation on two sides of the vinyl foam.][magnetic tape [silicone adhesive]][[hook and loop tape consisting of hooked part on sign back and looped side on mounting surface] [pin mount] for textile surfaces] [_____] fabricated from materials that are not corrosive to sign material and mounting surface.

2.2.4 Graphics

Signage graphics for modular signs must conform to the following:

[2.2.4.1 Subsurface Copy]

Copy is transferred to the back face of clear acrylic sheeting forming the panel face to produce precisely formed opaque image. This method bonds all sign elements (color, graphics, lettering, Braille and substrate) into a single unit.

[2.2.4.2 First Surface Copy Direct Print or Silkscreened (Non-Tactile)]

Message may be applied to panel using the silkscreen process. Silkscreened images must be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art is defined as artwork that is a first generation reproduction of the specified art. Edges and corners must be clean.

[2.2.4.3 Surface Applied Photopolymer]

Integral graphics and Braille achieved by photomechanical stratification processes. Photopolymer used for ADA compliant graphics must be of the type that has a minimum durometer reading of 90. Tactile graphics must be raised 0.8 mm from the first surface of plaque by photomechanical stratification process.

[2.2.4.4 Engraved Copy]

Machine engrave letters, numbers, symbols, and other graphics into panel sign on face to produce precisely formed copy and sharp images, incised to uniform depth. Melamine plastic engraving stock used for ADA compliant graphic must be three-ply lamination contrasting color core meeting ASTM D635.

[2.2.4.5 Graphic Blast Raised Copy]

Background is sandblasted to a uniform depth of 0.8 mm leaving raised text and Braille. Background must be painted with polyurethane paint.

[2.2.4.6 Embossed]

Methods other than sandblasting such as vacuum formed to create ADA
compliant projected graphics.

][2.2.4.7 Cast] [Fabricated] [Solid] Aluminum Letters

Provide [3] [6] [_____] mm thick and fasten to the message panel with concealed fasteners.

]2.2.5 Character Proportions and Heights

Letters and numbers on signs conform to 36 CFR 1191.

2.2.6 Tactile Letters, Symbols and Braille

Raised letters and numbers on signs must conform to 36 CFR 1191.

2.3 STAIR SIGNAGE

Provide signs on stairs serving three or more stories with special signage within the enclosure at each floor landing conforming to NFPA 101. Indicate the floor level, the terminus of the top and bottom of the stair enclosure, and the identification of the stair enclosure. Also, state the floor level of, and the direction to, exit discharge. Locate the signage inside the enclosure in a position that is visible when the door is in the open or closed position and install in conformance with 36 CFR 1191. The floor level designation must also be tactile in accordance with ICC A117.1 COMM.

2.4 BUILDING DIRECTORIES

Building directories must be lobby directories or floor directories, and must be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Dimensions, details, and materials of sign and message content must be as shown on the [drawings][attachments][signage placement schedule].

2.4.1 Header Panel

Header panel must [have background metal to match frame] [be acrylic with raised acrylic letters][be ES/MP plastic with raised letters] [_____] .

2.4.2 Doors

2.4.2.1 Door Glazing

Door glazing must be [in accordance with JIS R 3202, minimum 3 mm thick][clear acrylic sheet 5 mm thick conforming to [____]] [clear polycarbonate sheet 5 mm thick][____].

2.4.2.2 Door Construction

Extruded aluminum door frame must be of same finish as surrounding frame. Corners must be mitered [, reinforced] [, welded], and assembled with concealed fasteners. Hinges must be standard with the manufacturer, in finish to match frames and trim. Glazing must be set in frame with resilient glazing channels.

2.4.2.3 Door Locks

Door locks must be manufacturer's standard, and must be keyed alike.
Provide two sets of keys.

2.4.3 Fabrication

Extruded aluminum frames and trim must be assembled with corners [reinforced] [welded] and mitered to a hairline fit, with no exposed fasteners.

2.4.4 Illuminated Units

Illuminated directory units must have concealed internal [top] [back] lighting with [LED] [rapid start fluorescent tube lamp] [______], internal wiring, and lead at wire for connection. Electrical work must comply with NFPA 70 and must be UL or FM listed. Directory must consist of backlit photo negative directory strips and a black background. Unit must have a tinted [tempered safety solar glass][______] door.

2.4.4.1 Construction

The directory must be [50][100][150] mm deep frame constructed of an aluminum with [[satin [black][painted][dark bronze][______] anodized finish]][[red oak][walnut][______] with [natural][stained] finish]. Unit must be [[semi][fully] recessed][surface][______] mounted. Unit must have a [75][______] mm high header lettering as shown. Unit must have a [10][______] mm face door frame with concealed hinges and locking system or other secure method. Door frame must [match directory material and finish][______].

2.4.4.2 Message Strips

Message strips must be photo negative type updatable by user. Message strips must be [as shown on the drawings] [______].

2.4.5 Non-Illuminated Unit

Directory must consist of a non-illuminated unit with [machine or laser engraved copy in interchangeable acrylic, metal, or high-pressure plastic laminate strips] [screen printed or vinyl copy applied to acrylic, metal, or high-pressure plastic laminate strips] [vinyl or screen printed lettering on plastic film held in interchangeable plastic carriers] [screen printed or vinyl copy laminated to magnetic tape]. Design of unit must be as shown in the drawings.

2.4.5.1 Construction

The directory must be constructed of an aluminum [50][100][150] mm deep frame with [satin [black][painted][dark bronze][______] anodized finish][[red oak][walnut][______] with [natural][stained] finish]. Unit must be [[semi][fully] recessed][surface][______] mounted. Unit must have a [75][______] mm high header lettering as shown. Unit must have a [9.3][______] mm face door frame with concealed hinges and locking system or other secure method. Door frame must [match directory material and finish][______].

2.4.5.2 Message Strips

[Message strips must be updatable by user. ]Message strips must be [sized in accordance with manufacturer's standard] [______]. Letters and numbers must be provided in accordance with the [drawings] [schedule].
2.4.6 Electronic Directory System

Provide [non-interactive][interactive] electronic directory. Electronic directory system must be a complete turnkey system consisting of digital display, hardware, software connected through the local area network (LAN) to a [server][cloud]. Electrical equipment must be UL listed and must comply with NFPA 70. Unit must be [free-standing][wall mounted].

2.5 METAL PLAQUES

2.5.1 Cast Metal Plaques

2.5.1.1 Fabrication

Cast metal plaques must have the logo, emblem and artwork cast in the [bas relief] [flat relief] [_____] technique. Plaques must be fabricated from [prime aluminum] [bronze] [brass] [____].

2.5.1.2 Border

Border must be [flat band] [plain edge] [bevel] [custom ornamental] [____].

2.5.1.3 Finish

<table>
<thead>
<tr>
<th>Letter Finish</th>
<th>[satin] [polished]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Finish</td>
<td>[(light)[dark] aluminum][[dark][  ] bronze]</td>
</tr>
<tr>
<td>Background Texture</td>
<td>[leather][pebble][smooth][  ]</td>
</tr>
</tbody>
</table>

2.5.1.4 Mounting

Mounting must be [concealed] [rosettes and anchors] [rosettes and toggle bolts] [____].

2.5.2 Chemically Etched Metal Plaques

2.5.2.1 Fabrication

Plaque must be chemically etched one-piece or photochemically engraved metal sheet or plate [aluminum] [brass] [bronze] [zinc] [magnesium] [____] [____] mm thick.

2.5.2.2 Finish

[Single-etched raised areas must be in [gold-tone] [silver-tone] [bronze-tone] finish and recessed areas must be colorfilled.] [Double-etched raised areas must be [gold-tone] [silver-tone] and recessed textured areas must be [gold-tone] [silver-tone] colorfilled.]

2.6 DIMENSIONAL BUILDING LETTERS

2.6.1 Fabrication

Letters must be [cast][cutout][fabricated channel][molded plastic]. Letters must be [aluminum][bronze][brass][  ]. Package letters for protection until installation.
2.6.2 Size

Letter size must be [_____] [as indicated]. Provide letter thickness that is [manufacturer's standard for the size of letter][______].

2.6.3 Finish

Provide [mill][clear anodized][light][medium][dark] anodized bronze][polished] bronze with clear coat] [baked enamel] [powder coat][two-component acrylic polyurethane] finish.

2.6.4 Mounting

[Threaded studs] [Steel U-bracket, cap screws, and expansion bolts] of number and size recommended by manufacturer, must be supplied for concealed anchorage. Letters which project from the mounting surface must have [stud spacer sleeves] [______]. Letters, studs, and sleeves must be of the same material. Templates for mounting must be supplied.

2.7 PRESSURE SENSITIVE LETTERS

2.7.1 Fabrication

Ensure that vinyl letter edges and corners of finished letterforms and graphics are true and clean. Do not use letterforms and graphics with rounded positive or negative corners, nicked, cut, or ragged edges.

2.7.2 Size

Letter size: [as indicated] [______].

2.8 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions must be at least 3 mm thick, and aluminum plate or sheet must be at least 1.3 mm thick. Extrusions must conform to JIS H 4040; plate and sheet must conform to JIS H 4000. Where anodic coatings are specified, alloy must conform to [______]. Exposed anodized aluminum finishes must be as shown. Welding for aluminum products must conform to JIS Z 3801, JIS Z 3410, and JIS Z 3841.

2.9 ANODIC COATING

Anodized finish must conform to JIS H 8602 as follows:

a. [Clear (natural).]

b. [Integral color.]

c. [Electrolytically deposited color-anodized.]

2.10 ORGANIC COATING

Organic coating must conform to JIS K 5906, with total dry film thickness not less than 0.030 mm.
2.11 FABRICATION AND MANUFACTURE

2.11.1 Factory Workmanship

Holes for bolts and screws must be drilled or punched. Drilling and punching must produce clean, true lines and surfaces. Exposed surfaces of work must have a smooth finish and exposed riveting must be flush. Fastenings must be concealed where practicable.

2.11.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.12 COLOR, FINISH, AND CONTRAST

Color must be [in accordance with Section 09 06 00 SCHEDULES FOR FINISHES] [as indicated] [______]. Finish of all signs must be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

2.13 TYPEFACE

[ADA-ABA compliant font for Room Signs][Helvetica Regular][______].

PART 3 EXECUTION

3.1 INSTALLATION

Signs must be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the [detail drawings] [schedule below] [attachments]. Submit [six] [______] copies of operating instructions outlining the step-by-step procedures required for system operation. The instructions must include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set must be permanently bound and must have a hard cover. The following identification must be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Mounting height and mounting location must conform to 36 CFR 1191. Required blocking must be installed. Signs on doors or other surfaces must not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces must be installed with matching blank back-up plates in accordance with manufacturer's instructions. [Illuminated signage must be in conformance with the requirements of Section 26 51 00 INTERIOR LIGHTING.]

<table>
<thead>
<tr>
<th>Door/Room Number</th>
<th>Sign Type</th>
<th>Text</th>
<th>Insert(s)</th>
<th>Symbol/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>[_____]</td>
<td>[_____]</td>
<td>[_____]</td>
<td>[_____]</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

Do not install items that show visual evidence of biological growth.

3.1.1 Anchorage

Anchorage must be in accordance with approved manufacturer's instructions.
In high humidity interior spaces (for example, bathrooms, locker rooms, pools, trainers) and unconditioned spaces, use corrosion-resistant anchors/fasteners or with approval by the manufacturer, waterproof silicone adhesive. Anchorage not otherwise specified or shown must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials must be compatible with metal to which applied and must have matching color and finish. At interior applications in heavy traffic areas, firmly attach signage to structure walls with tamper-proof fasteners.

a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.

b. Mount signs mounted to lay-in ceiling grids with clip connections to ceiling tees.

c. Install signs mounted on metal surfaces with magnetic tape.

d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.

3.1.2 Protection and Cleaning

Protect the work against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions and the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, Package 1. Submit [six] [_____] copies of maintenance instructions listing routine procedures, repairs, and guides.

-- End of Section --
SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 21 13

TOILET COMPARTMENTS

08/17

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1.3 REGULATORY REQUIREMENTS
1.4 DELIVERY, STORAGE, AND HANDLING
1.5 WARRANTY

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  2.2.2 Sound-Deadening Cores
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  2.2.4 Brackets
  2.2.5 Hardware and Fittings
    2.2.5.1 General Requirements
    2.2.5.2 Finishes
  2.2.6 Door Hardware
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    2.2.6.2 Latch and Pull
    2.2.6.3 Coat Hooks
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  2.3.3 Urinal Screens
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2.5 FLOOR-ANCHORED PARTITIONS
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3.7 FINAL ADJUSTMENT
3.8 CLEANING

-- End of Section Table of Contents --
PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)


JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS G 3203 (1988) Alloy Steel Forgings for Pressure Vessels for High-Temperature Service

JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip

JIS G 4304 (2012) Hot-Rolled Stainless Steel Plate, Sheet and Strip

JIS H 3100 (2018) Copper and Copper Alloy Sheets, Plates and Strips


JIS H 5301 (2018) Zinc Alloy Die Castings

JIS H 8601 (1999) Anodic Oxide Coatings on Aluminum and Aluminum Alloys

JIS H 8617 (1999) Electroplated Coatings of Nickel and Chromium

JIS H 8641 (2007) Hot Dip Galvanized Coatings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Fabrication Drawings
Installation Drawings; G[, [_____]]
SD-07 Certificates
Warranty
SD-10 Operation and Maintenance Data
Plastic Identification; G[, [_____]]

1.3 REGULATORY REQUIREMENTS

Conform to ICC A117.1 COMM code for access for the handicapped operation of toilet compartment door and hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.5 WARRANTY

Provide certification or warranties that toilet partitions will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than [_____] years after completion.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

Provide a complete and usable toilet partition system, including toilet enclosures, room entrance screens, urinal screens, system of panels, hardware, and support components. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent
catalog data. Submit Fabrication Drawings for metal toilet partitions and
urinal screens consisting of fabrication and assembly details to be
performed in the factory. Submit manufacturer's Cleaning and Maintenance
Instructions with Fabrication Drawings for review.

2.1.1 Plastic Identification

Verify that plastic products to be incorporated into the project are
labeled in accordance with JIS K 6899. Where products are not labeled,
provide product data indicating polymeric information in the Operation and
Maintenance Manual.

<table>
<thead>
<tr>
<th>Type</th>
<th>Plastic Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Polyethylene Terephthalate (PET, PETE)</td>
</tr>
<tr>
<td>Type 2</td>
<td>High Density Polyethylene (HDPE)</td>
</tr>
<tr>
<td>Type 3</td>
<td>Vinyl (Polyvinyl Chloride or PVC)</td>
</tr>
<tr>
<td>Type 4</td>
<td>Low Density Polyethylene (LDPE)</td>
</tr>
<tr>
<td>Type 5</td>
<td>Polypropylene (PP)</td>
</tr>
<tr>
<td>Type 6</td>
<td>Polystyrene (PS)</td>
</tr>
</tbody>
</table>
| Type 7 | Other. Use of this code indicates that the package in question is
         made with a resin other than the six listed above, or is made of
         more than one resin listed above, and used in a multi-layer
         combination.|

2.2 MATERIALS

2.2.1 Galvanized Steel Sheet

Provide galvanized steel sheet cold-rolled, stretcher-level, commercial
quality material, conforming to JIS G 3302. Conform surface preparation of
material for painting to JIS H 8617.

2.2.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores
with a cell size of not more than 25 mm. Resin-material content must weigh
not less than 11 percent of the finished core weight. Expanded cores must
be faced on both sides with kraft paper.

2.2.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after
fabrication, in conformance with JIS G 3302 and JIS H 8641. Conceal all
galvanized anchoring devices.

2.2.4 Brackets

Wall brackets must be two-ear panel brackets, T-style, 25 mm stock.
Provide stirrup style panel-to-pilaster brackets.
2.2.5 Hardware and Fittings

2.2.5.1 General Requirements

Conform hardware for the toilet partition system for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply latching devices and hinges for handicap compartments with 36 CFR 1191; provide [chrome-plated steel] [ or ] [stainless steel] devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

<table>
<thead>
<tr>
<th>Material</th>
<th>Conformance Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold-rolled sheet steel</td>
<td>JIS G 3203, commercial quality</td>
</tr>
<tr>
<td>Zinc-base alloy</td>
<td>JIS H 5301 ZDC-1</td>
</tr>
<tr>
<td>Brass</td>
<td>JIS H 3100, Alloy C26800</td>
</tr>
<tr>
<td>Aluminum</td>
<td>JIS H 4040</td>
</tr>
<tr>
<td>Corrosion-resistant steel</td>
<td>JIS G 4304, Type [SUS302][SUS304]</td>
</tr>
</tbody>
</table>

2.2.5.2 Finishes

[ a. Chrome plating must conform to JIS H 8617.]
[ b. Finish must conform to JIS H 8617, Class I (Corrosion Protective Plasting), Type [I, Bright] [II, Satin].]
[ c. Aluminum must have a clear anodic coating conforming to JIS H 8601.]
[ d. Corrosion-resistant steel must have a No. 4 finish.]
[ e. Exposed fasteners must match the hardware and fittings.]

2.2.6 Door Hardware

2.2.6.1 Hinges

Hinges must be adjustable to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors to 10 degrees. Provide self-lubricating hinges with the indicated swing. Hinges must [be the surface-mounted type.] [be the cutout-insert type.] [have the following type of return movement:]

[ a. Gravity return movement]
[ b. Spring-action cam return movement]
[ c. Torsion-rod return movement]
2.2.6.2 Latch and Pull

Latch and pull must be a combination rubber-faced door strike and keeper equipped with emergency access.

2.2.6.3 Coat Hooks

Coat hooks must be combination units with hooks and rubber tipped pins.

2.3 PARTITION PANELS AND DOORS

Fabricate partition panels and doors not less than 25 mm thick with face sheets not less than 1.006 mm thick.

[Provide painted steel toilet partitions and screens with recycled content of 27 percent minimum. Provide data identifying percentage of recycled content for painted steel partitions and screens. ] [Provide stainless steel toilet partitions and screens with recycled content of 50 percent minimum. Provide data identifying percentage of recycled content for stainless steel partitions and screens.] [Provide plastic laminate toilet partitions and screens with recycled content of 45 percent minimum. Provide data identifying percentage of recycled content for plastic laminate partitions and screens.] [Provide solid polyethylene toilet partitions and screens with recycled content of 30 percent minimum. Provide data identifying percentage of recycled content for plastic, solid polyethylene partitions and screens.]

Provide laminated plastic and solid phenolic toilet partitions and urinal screens to meet the emissions requirements of JIS A 1901 (use the office or classroom requirements, regardless of space type). [Provide certification or validation of indoor air quality for laminated plastic partitions and screens. ][Provide certification or validation of indoor air quality for plastic, solid phenolic partitions and screens.]

2.3.1 Toilet Enclosures

Provide Style [A, floor supported] [B, ceiling hung] [C, overhead braced] [F, overhead braced-alcove]. Furnish width, length, and height of toilet enclosures as shown. [Provide a width of 25 mm.] Finish surface of panels must be [painted metal, Finish 1][stainless steel, Finish 2][laminated plastic, Finish 3][solid phenolic, black core Finish 4][solid phenolic, color through the core Finish 4A][solid polyethylene, Finish 5][____]; water resistant; graffiti resistant; non-absorbent; [with plastic face sheets permanently fused to plastic core; 6 mm radius beveled edges]. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 1112 N. Grab bars must not rotate within their fittings.

2.3.2 Room Entrance Screens

Provide Style [A, floor anchored] [B, ceiling hung braced] [C, overhead braced] [D, wall hung] [____]. Provide finish surface of screens to be [painted metal, Finish 1][stainless steel, Finish 2][laminated plastic, Finish 3][solid phenolic, black core Finish 4][solid phenolic, color through the core Finish 4A][solid polyethylene, Finish 5][____]; water resistant; graffiti resistant; non-absorbent[; with plastic face sheets permanently fused to plastic core; 6 mm radius beveled edges]. Furnish length and height of screens as shown. [Provide thickness of 25 mm.]
Fabricate screens from the same types of panels, pilasters, and fittings as the toilet partitions.

### 2.3.3 Urinal Screens

Provide and conform urinal screens Style [A, floor supported] [B, ceiling hung] [C, overhead braced] [D, floor to ceiling hung] [E, floor to ceiling post supported]. Provide finish for surface of screens as [painted metal, Finish 1] [stainless steel, Finish 2] [laminated plastic, Finish 3] [solid phenolic, black core Finish 4] [solid phenolic, color through the core Finish 4] [solid polyethylene, Finish 5] [_____] ; water resistant; graffiti resistant; non-absorbent; [with plastic face sheets permanently fused to plastic core; 6 mm radius beveled edges]. Furnish width and height of urinal screens as shown. [Provide thickness of 25 mm.] Secure wall hung urinal screens with [a minimum of three wall stirrup brackets.] [1050 mm long, continuous flanges.] Fabricate screens from the same types of panels and pilasters as the toilet partitions. Use corrosion-resistant stainless steel fittings and fasteners.

### 2.4 CEILING-HUNG PARTITIONS

Pilasters must be not less than 31.75 mm thick with face sheets not less than 1.613 mm thick. Anchoring device at the top of the pilaster must be welded to the reinforced face sheets and must have not less than two 9.525 mm round threaded rods, lock washers, and leveling-adjustment nuts. Anchoring device must be designed to transmit the strain and loading on the pilaster directly to the structural support above without putting strain or loading on the finished ceiling. Trim piece at the top of the pilaster must be 76.2 mm high and fabricated from not less than 0.762 mm thick stainless steel.

### 2.5 FLOOR-ANCHORED PARTITIONS

Pilasters must be not less than 31.75 mm thick with face sheets not less than 1.613 mm thick. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 12.7 by 22.2 mm welded to the reinforced face sheets and having not less than two 9.5 mm round anchorage devices for securing to the floor slab. Provide anchorage devices complete with threaded rods, expansion shields, lock washers, and leveling-adjustment nuts. Trim piece at the floor must be 76.2 mm high and fabricated from not less than 0.76 mm thick corrosion-resistant stainless steel.

### 2.6 OVERHEAD-BRACED PARTITIONS

Pilasters must be not less than 31.75 mm thick with face sheets not less than 1.0 mm thick. Provide anchoring device at the bottom of the pilaster consisting of a channel-shaped floor stirrup fabricated from not less than 1.6 mm thick material and a leveling bolt. Secure the stirrup to the pilaster with not less than a 4.76 mm bolt and nut after the pilaster is leveled. Secure the stirrup to the floor with not less than two lead expansion shields and sheetmetal screws. Fabricate overhead brace from a continuous extruded aluminum tube not less than 25 mm wide by 38 mm high, 3.2 mm wall thickness. Finish must be clear anodized with a minimum 0.4 mils or thicker in accordance with JIS H 8601. Set and secure brace into the top of each pilaster. Fabricate 75 mm high trim piece at the floor from not less than 0.75 mm thick corrosion-resistant stainless steel.
2.7 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Pilaster shoes must be [aluminum] [stainless steel] [one piece molded HDPE] [______]. Height must be 76 mm.

2.8 HARDWARE

Provide hardware for the toilet partition system for the specified type and style of partitions. [Provide hardware pre-drilled by manufacturer.] Use a hardware finish that is highly resistant to alkalis, urine, and other common toilet room acids. [Hardware includes: chrome plated non ferrous cast pivot hinges, gravity type, adjustable for door close positioning; nylon bearings; [black anodized] [chrome plated] [_____] aluminum door latch; door strike and keeper with rubber bumper; and cast alloy chrome plated coat hook and bumper, [______].] Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and [chrome-plated steel] [or] [stainless steel] door latches that operate without either tight grasping or twisting of the wrist of the operator. Use stainless steel, tamper proof type screws and bolts. Wall mounting brackets must be continuous, full height, [aluminum] [stainless steel] [heavy duty plastic] [______], in accordance with toilet compartment manufacturer's instructions.

2.9 COLORS AND FINISHES

2.9.1 Colors

Provide manufacturer's standard color charts for color of finishes for toilet partition system components. [Color of pilaster shoes must match the core of solid plastic compartments and screens.] Submit three samples showing a finished edge on two adjacent sides and core construction, each not less than 304.8 mm square.

2.9.2 Finishes No. 1 Through No. 3

Conform partitions, panels, screen, and door finishes finished with [Finish No. 1, baked enamel] [Finish No. 2, stainless steel] [Finish No. 3, laminated plastic].

2.9.3 Finishes No.4 and No. 5

Provide solid plastic fabricated of [solid phenolic core with melamine facing sheets] [or] [polymer resins (polyethylene)] formed under high pressure rendering a single component section not less than 25 mm thick. Colors must extend throughout the panel thickness. Provide exposed finish surfaces: smooth, waterproof, non-absorbent, and resistant to staining and marking with pens, pencils, or other writing devices. Solid plastic partitions must not show any sign of deterioration when immersed in the following chemicals and maintained at a temperature of 27 degrees C for a minimum of 30 days:

<table>
<thead>
<tr>
<th>Acetic Acid (80 percent)</th>
<th>Hydrochloric Acid (40 percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>Hydrogen Peroxide (30 percent)</td>
</tr>
</tbody>
</table>
Ammonia (liquid) | Isopropyl Alcohol
---|---
Ammonia Phosphate | Lactic Acid (25 percent)
Bleach (12 percent) | Lime Sulfur
Borax | Nicotine
Brine | Potassium Bromide
Caustic Soda | Soaps
Chlorine Water | Sodium Bicarbonate
Citric Acid | Trisodium Phosphate
Copper Chloride | Urea; Urine
Core Oils | Vinegar

PART 3  EXECUTION

3.1  PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2  METAL PARTITION FABRICATION

a. Fabricate metal Partition Panels, doors, screens, and pilasters required for the project from galvanized-steel face sheets with formed edges. Face sheets must be pressure-laminated to the sound-deadening core with edges sealed with a continuous locking strip and corners mitered and welded. Ground all welds smooth. Provide concealed reinforcement for installation of hardware, fittings, and accessories. Surface of face sheets must be smooth and free from wave, warp, or buckle.

b. Before application of an enamel coating system, solvent-clean galvanized-steel surfaces to remove processing compounds, oils, and other contaminants harmful to coating-system adhesion. After cleaning, coat the surfaces with a metal-pretreatment phosphate coating. After pretreatment, finish exposed galvanized-steel surfaces with a baked-enamel coating system as specified.

c. Provide an enamel coating system consisting of a factory-applied baked acrylic enamel coating system. Coating system must be a durable, washable, stain-resistant, mar-resistant finish.
3.3 INSTALLATION

Do not install items that show visual evidence of biological growth. Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 13 mm and secure the panels to walls and pilasters with not less than two wall brackets attached near the top and bottom of the panel. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure Panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

a. Secure panels to hollow plastered walls with toggle bolts using not less than M6x1 screws of the length required for the wall thickness. Toggle bolts must have a load-carrying strength of not less than 2668.9 N per anchor.

b. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than M6x1 screws of the length required for the wall thickness. Toggle bolts must have a load-carrying strength of not less than 2668.9 N per anchor.

c. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than M6x1 screws, with a shield length of not less than 38 mm. Expansion shields must have a load-carrying strength of not less than 2668.9 N per anchor.

d. Submit Installation Drawings for metal toilet partitions and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.4 CEILING-HUNG PARTITIONS

Secure pilasters to the structural support above with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level the bottoms of doors with bottoms of pilasters when doors are in a closed position.

3.5 FLOOR-ANCHORED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level tops of doors with tops of pilasters when doors are in a closed position. Expansion shields must have a minimum 50 mm penetration into the concrete slab.

3.6 OVERHEAD-BRACED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Secure overhead brace to the pilaster face with not less than two fasteners per face. Expansion shields must have a minimum 50 mm penetration into the concrete slab. Make tops of doors parallel with the overhead brace when doors are in a closed position.
3.7 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors must have a uniform vertical edge clearance of approximately 5 mm and must rest open at approximately 30 degrees when unlatched.

3.8 CLEANING

Baked enamel finish must be touched up with the same color of paint that was used for the finish. Clean all surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --
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DIVISION 10 - SPECIALTIES

SECTION 10 28 13

TOILET ACCESSORIES

08/17

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1.3   CERTIFICATIONS
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1.4   DELIVERY, STORAGE, AND HANDLING
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PART 2   PRODUCTS

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   2.1.2   Finishes
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   2.2.29   Folding Shower Seat (FSS)
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3.2  CLEANING
3.3  SCHEDULE

-- End of Section Table of Contents --
PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS R 3220 (2011) Glass in Building - Silvered, Flat-Glass Mirror

JIS Z 2911 (2018) Methods of Test for Fungus Resistance


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Finishes; G[, [_____]]
Accessory Items

SD-10 Operation and Maintenance Data

Electric Hand Dryer; G[, [_____]}

[1.3 CERTIFICATIONS

1.3.1 Baby Changing Stations

Provide certification that baby changing stations meet the performance criteria of ASTM F2285.

Provide certification that baby changing stations safety signage meet the requirements of JIS Z 9103, ISO 3864 or ISO 7010.

Provide certification that baby changing stations meet the testing requirements of JIS Z 2911.

1.4 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09 30 10 CEMENT TILING, QUARRY TILING, AND PAVER TILING. Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide [tamperproof design] [oval heads] exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

<table>
<thead>
<tr>
<th>Metal</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless steel</td>
<td>No. 4 satin finish</td>
</tr>
<tr>
<td>Carbon steel, copper alloy, and brass</td>
<td>Chromium plated, bright</td>
</tr>
</tbody>
</table>
2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

2.2.1 Facial Tissue Dispenser (FTD)

Provide [surface] [recessed] mounted facial tissue dispenser, Type 304 stainless steel face, [satin finish] [bright polished finish]. Secure face of recessed dispenser by friction with suitable spring steel clips. Provide a minimum capacity of [150] [200] [300] two-ply tissues for dispenser.

2.2.2 Grab Bar (GB)

Provide an 18 gauge, 32 mm grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide [concealed] [exposed] mounting flange. Provide grab with [satin finish] [peened non-slip surface]. Furnish installed bars capable of withstanding a 2.225 kN vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 38 mm space between wall and grab bar.

2.2.3 Medicine Cabinet (MC)

Construct medicine cabinet with cold-rolled carbon steel sheet of minimum 0.76 mm thickness, formed from a single sheet of steel or mechanically formed and spot welded. Provide width, height and depth of cabinet in accordance with paragraph SCHEDULE.

2.2.3.1 Sliding Door Cabinet

Provide [surface mounted vanity] [recessed cabinet] sliding door cabinet assembly with design and lighting arrangement as indicated. Provide a minimum of 2 shelves per cabinet. Provide [a wide] [a narrow] [no] frame mirror.

2.2.3.2 Swinging Door Cabinet

Provide swinging door cabinet assembly, including the lighting arrangement, as indicated. Provide [surface] [recess] mounted assembly. Locate cabinet centrally behind the door with a minimum of two shelves. Provide stainless steel or carbon steel door hinges. Provide permanent type magnets used in door catches. Provide doors [with] [without] a mirror.

2.2.4 Mirrors, Glass (MG)

Provide clear glass for mirrors conforming to JIS R 3220. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 6 mm thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing
paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.5 Mirror, Metal (MM)

Provide a brightly polished stainless steel metal mirror of 0.94 mm minimum thickness, edges turned back 6 mm and recess fitted with tempered hardboard backing, and theft-proof fasteners. Provide size in accordance with paragraph SCHEDULE.

2.2.6 Mirror, Tilt (MT)

Provide surface mounted tilt mirror with full visibility for persons in a wheelchair. Furnish [adjustable] [fixed] tilt mirror, extending at least 100 mm from the wall at the top and tapering to 25 mm at the bottom. Provide size in accordance with [paragraph SCHEDULE] [the drawings] [____]. Conform to JIS R 3220 and paragraph Glass Mirrors.

2.2.7 Paper Towel Dispenser (PTD)

Provide [____] paper towel dispenser constructed of a minimum [22 gauge carbon steel] [0.7 mm Type 304 stainless steel], [surface] [recessed] mounted. Provide a towel compartment and a [mirror door] [and] [liquid soap dispenser] for each dispenser. Furnish [tumbler key lock] [concealed tumbler key lock] locking mechanism.

2.2.8 Combination Paper Towel Dispenser/Waste Receptacle (PTDWR)

Provide [recessed] [semi-recessed] dispenser/receptacle with a capacity of [400] [600] [____] sheets of C-fold, single-fold, or quarter-fold towel. Design waste receptacle to be locked in unit and removable for service. Provide tumbler key locking mechanism. Provide waste receptacle capacity of [45] [68] [____] L. Fabricate a minimum 0.7 mm stainless steel welded construction unit with all exposed surfaces having a satin finish. Provide waste receptacle that accepts reusable liner standard for unit manufacturer.

2.2.9 Sanitary Napkin Disposer (SND)

Construct a Type 304 stainless steel sanitary napkin disposal with removable leak-proof receptacle for disposable liners. Provide [fifty] [____] disposable liners of the type standard with the manufacturer. Retain receptacle in cabinet by tumbler lock. Provide disposer with a door for inserting disposed napkins, [recessed] [partition mounted, double access] [surface mounted].

2.2.10 Sanitary Napkin and Tampon Dispenser (SNTD)

Provide sanitary napkin and tampon dispenser [surface mounted] [recessed]. Dispenser, including door of Type 304 stainless steel that dispense both napkins and tampons with a minimum capacity of 20 each. Furnish dispensing mechanism for [complimentary] [coin] operation. Provide coin mechanisms with minimum denominations of [____] [free]. Hang doors with a full-length corrosion-resistant steel piano hinge and secure with a tumbler lock. Provide keys for coin box different from the door keys.

2.2.11 Shower Curtain (SC)

Provide [____] shower curtain, size to suit conditions. Provide
anti-bacterial nylon/vinyl fabric curtain. Furnish [_____] color [as shown in Section 09 06 00 SCHEDULES FOR FINISHES].

2.2.12 Shower Curtain Rods (SCR)

Provide Type 304 stainless steel shower curtain rods 32 mm OD by 1.24 mm minimum [straight] [bent as required] to meet installation conditions.

2.2.13 Soap Dispenser (SD)

Provide soap dispenser [surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 1.2 L with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.] [surface mounted, powder type constructed of stainless steel or chromium plated zinc die casting, containing a swap feed mechanism and an agitator designed to break up powdered soap, with a minimum capacity of 0.94 L.] [lavatory mounted, liquid type consisting of a polyethylene tank with a minimum 0.94 L holding capacity and a [100 mm] [150 mm] spout length.]

2.2.14 Soap Holder (SH)

Provide [surface mounted] [recessed] Type 304 stainless steel soap holder. Provide stainless steel separate supports.

2.2.15 Shelf, Metal, Heavy Duty (SMHD)

Furnish a minimum 18 gauge stainless steel heavy duty metal shelf with hemmed edges. Provide shelves over 750 mm with intermediate supports. Provide minimum of 16 gauge supports, welded to the shelf, and spaced no more than 750 mm apart.

2.2.16 Shelf, Metal, Light Duty (SMLD)

Support light duty metal shelf between brackets or on brackets. Purpose of brackets is to prevent lateral movement of the shelf. Furnish [450 mm] [600 mm] long shelf. Provide stainless steel shelf and brackets.

2.2.17 Soap and Grab Bar Combination, Recessed (SGR)

Provide recessed type, Type 304 stainless steel soap and grab bar combination [bright polished finish] [satin finish].

2.2.18 Hand Sanitizer Dispenser (HSD)

Provide hand sanitizer dispensers complete with mounting brackets, batteries as recommended by manufacturer, sanitizer solution, and one bottle of refill sanitizer solution for each dispenser installed. Dispenser properties and characteristics:

a. Wall mounted

b. Battery operated

c. Automatic, touchless type that dispenses sanitizer when a hand is placed in proximity of a sensor

d. Integral tray below the dispensing portal to catch wasted sanitizer
e. Operated using standard size batteries

2.2.19 Towel Bar (TB)

Provide stainless steel towel bar with a minimum thickness of 0.38 mm. Provide minimum 19 mm diameter bar, or 16 mm square. Provide [bright polish] [satin] finish.

2.2.20 Towel Pin (TP)

Provide towel pin with concealed wall fastenings, and a pin integral with or permanently fastened to wall flange with maximum projection of 100 mm. Provide [bright polish] [satin] finish.

2.2.21 Toilet Tissue Dispenser (TTD)

Furnish [surface mounted] [recess mounted] toilet tissue holder with two rolls of standard tissue [mounted horizontally] [stacked vertically]. Provide [carbon steel, bright chromium plated] [stainless steel, satin] finish cabinet.

2.2.22 Toilet Tissue Dispenser, Jumbo (TTDJ)

Provide surface mounted toilet tissue dispenser with 2 rolls of jumbo tissue. Fabricate cabinet of [Type 304, 18 gauge stainless steel with Type 304, 20 gauge stainless steel door] [high-impact plastic body and transparent plastic front cover]. Provide cover with key lock.

2.2.23 Toothbrush and Tumbler Holder (TTH)

Provide stainless steel, surface mounted toothbrush and tumbler holder. Furnish holder to hold a minimum of four toothbrushes in a vertical position. Provide 57 plus or minus 3 mm in diameter size of hole for securing tumbler.

2.2.24 Waste Receptacle (WR)

Provide Type 304 stainless steel waste receptacle, designed for [recessed] [surface] mounting. Provide reusable liner, of the type standard with the receptacle manufacturer. Provide a minimum [_____] cubic meters capacity. Provide receptacles with push doors and doors for access to the waste compartment with continuous hinges. Furnish [tumbler key lock] [_____] locking mechanism.

2.2.25 Toilet Seat Cover Dispenser (TSCD)

Provide Type 304 stainless steel with [recessed mounted] [surface mounted] toilet seat cover dispensers. Provide dispenser with a minimum capacity of 500 seat covers.

2.2.26 Toilet Seat Cover/Tissue Dispenser/Waste Receptacle (TSCTDWR)

Provide stainless steel and [partition mounted] [recessed mounted] [surface mounted] toilet seat cover, tissue dispenser, and waste receptacle combination. Provide a minimum of 500 [seat covers] [seat covers per side] and [2] [4 (2 per side)] standard tissue rolls for each dispenser. Provide a waste receptacle of the reusable liner of type standard with the receptacle manufacturer. Provide receptacle with [_____] cubic meters capacity. Furnish [tumbler key lock] [_____] locking mechanism.
2.2.27 Electric Hand Dryer (EHD)

Provide wall mount and electric hand dryer designed to operate at [_____] phase alternating current with a heating element core rating of a maximum [______]. Provide dryer housing of single piece construction and of [white porcelain enamel] [chrome plated steel] [baked electrostatically applied epoxy] [______]. Submit [4] [_____] complete copies of maintenance instructions listing routine maintenance procedures and possible breakdowns. Include repair instructions for simplified wiring and control diagrams and other information necessary for unit maintenance.

2.2.28 Diaper Changing Station (DCS)

Provide [recess mount] [surface mounted] diaper changing station fabricated of high impact plastic with no sharp edges. Provide fold down platform concave to the child's shape, equipped with nylon and hook and loop safety straps and engineered to withstand a minimum static load of[ 155 kg] [ 113 kg]. Provide an integral dispenser for sanitary liners for each unit. Provide pictorial for universal use of safety graphics conforming to JIS Z 2911, ISO 3864 or ISO 7010. Provide stations that comply with these standards: ASTM F2285 Standard Safety Performance Specification for Diaper Changing tables for Commercial Use. Furnish color [______] [as shown in Section 09 06 00 SCHEDULES FOR FINISHES].

2.2.29 Folding Shower Seat (FSS)

Folding shower seat must have a frame constructed of type-304 satin finish stainless steel, 16-gauge, 32 mm square tubing, and 18-gauge, 25 mm diameter seamless tubing. Seat must be constructed of one-piece, 13 mm thick water-resistant, ivory colored solid phenolic with black edge. Clearance between back of shower seat and wall must be 38 mm to comply with ADA Accessibility Guidelines (ADAAG). Seat supports must not come into contact with the floor. Seat must be able to lock in upright position when not in use. Seat must be attached to wall by two 75 mm diameter mounting flanges constructed of type-304, 5 mm thick stainless steel with satin finish. Manufacturer's service and parts manual must be provided to building owner/manager upon completion of project.

2.2.30 Mop and Broom Holder (MH)

Stainless steel with grip jaw cam mechanism securing [3][4][5] mop or broom handles. [Also includes [hooks][ and ][storage shelf].]

PART 3 EXECUTION

3.1 INSTALLATION

Do not install items that show visual evidence of biological growth. Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. [Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation.] After installation, thoroughly clean exposed surfaces and
restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, PTFE or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

3.3 SCHEDULE

<table>
<thead>
<tr>
<th>Room or Space</th>
<th>MG</th>
<th>PTD</th>
<th>SMLD</th>
<th>SD</th>
<th>SH</th>
<th>TTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>[_____]</td>
<td>[_____]</td>
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</tbody>
</table>

-- End of Section --
PART 1 GENERAL

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1.2 REFERENCES
1.3 SUBMITTALS
1.4 CERTIFICATIONS
   1.4.1 Window Blinds
1.5 DELIVERY, STORAGE, AND HANDLING
1.6 WARRANTY

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      2.1.1.2 Controls
      2.1.1.3 Intermediate Brackets
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   2.1.2 Light Control and Privacy Blinds
   2.1.3 Vertical Blinds
      2.1.3.1 Louvers
      2.1.3.2 Carriers
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PART 3 EXECUTION

3.1 EXAMINATION
3.2 WINDOW TREATMENT PLACEMENT SCHEDULE
3.3 INSTALLATION
3.4 CLEAN-UP

-- End of Section Table of Contents --
PART 1 GENERAL

1.1 SUMMARY

Provide window treatment, complete with necessary brackets, fittings, and hardware. Provide each window treatment type as a complete unit in accordance with paragraph WINDOW TREATMENT PLACEMENT SCHEDULE. Mount and operate equipment in accordance with manufacturer's instructions. Completely cover windows to receive a treatment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)


1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES

SD-02 Shop Drawings
    Installation

SD-10 Operation and Maintenance Data
    Window Blinds; G[, [_____]]

1.4 CERTIFICATIONS

1.4.1 Window Blinds

Provide products certified to meet indoor air quality requirements by JIS A 1901 or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets
the indoor air quality product requirements cited herein.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 10 degrees C. Do not open containers until needed for installation unless verification inspection is required.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Provide each blind, including hardware, accessory items, mounting brackets and fastenings, as a complete unit produced by one manufacturer. Unless otherwise indicated, all parts will be the same color and will match the color of the blind slat. Treat steel features for corrosion resistance. Submit product data and samples of each type and color of window treatment. Provide [slat][louver] samples 150 mm in length for each color. Window blinds must meet emissions requirements of JIS A 1901 (use the office or classroom requirement, regardless of space type). Provide certification or validation of indoor air quality for window blinds.

2.1.1 Horizontal Blinds

Provide horizontal blinds with [50 mm][25 mm] slats. Blind units must be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds must be [inside][outside] mount. Provide tapes for 50 mm slats with longitudinal reinforced vinyl plastic in 1-piece turn ladder construction. Tapes for 25 mm slats must be braided polyester or nylon.

2.1.1.1 Head Channel and Slats

Provide head channel made of [steel or] aluminum with corrosion-resistant finish nominal [0.46 mm for 50 mm][0.61 mm for 25 mm] slats. Provide slats of aluminum, not less than [0.203][0.152][0.813] mm thick, and of sufficient strength to prevent sag or bow in the finished blind. Provide a sufficient amount of slats to assure proper control, uniform spacing, and adequate overlap. Enclose all hardware in the headrail.

2.1.1.2 Controls

A transparent tilting wand will be provided to tilt the slats, it will hang vertically by its own weight, and will swivel for easy operation. Provide a tilter control of enclosed construction. Provide moving parts and mechanical drive made of compatible materials which do not require lubrication during normal expected life. The tilter will tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. Include a mechanism to prevent over tightening. Provide a
wand of sufficient length to reach to within 1500 mm of the floor. [Provide cordless blinds or blinds with cords that are out of reach of children and strangle proof.]

2.1.1.3 Intermediate Brackets

Provide intermediate brackets for installation, as recommended by the manufacturer, of blinds over [1200][1500][2100] mm wide.

2.1.1.4 Bottom Rail

Provide bottom rail made of corrosion-resistant steel with factory applied finish. Provide closed oval shaped bottom rail with double-lock seam for maximum strength. Bottom rail and end caps to match slats in color.

2.1.1.5 Braided Ladders

Provide braided ladders of 100 percent polyester yarn, color to match the slat color. Space ladders 15.2 slats per 300 mm of drop in order to provide a uniform overlap of the slats in a closed position.

2.1.1.6 Hold-Down Brackets

Provide universal type hold-down brackets for sill or jamb mount where indicated on placement list.

2.1.2 Light Control and Privacy Blinds

In addition to requirements for horizontal blinds, provide each unit with a feature that offers hidden slat holes for maximum light control and privacy.

2.1.3 Vertical Blinds

Provide vertical blind units capable of nominal 180 degree partial tilting operation and full stackback. Provide blinds that are listed by the manufacturer as designed for heavy duty strength applications including heavy duty hardware. Provide [ceiling][wall] mounted vertical blinds with [outside][inside] brackets. Provide blinds that are [sill][floor] length. Outside mount type installation must provide adequate overlap to control light and privacy.

2.1.3.1 Louvers

Provide louvers [which are fire resistant solid vinyl, UV stable, and impact resistant.][which are flame retardant fabric having straight, flat, unfrayed edges and flat, without noticeable twists. Provide a weight at the bottom of the louver without the insert discoloring the fabric.][which are groover extruded from solid vinyl with clear non-yellowing channel lips to accept fabric inserts. Provide fabric inserts that are flame retardant and colorfast.] Louvers that are[ 90 mm must overlap not less than 10 mm][ 50 mm must overlap not less than mm] and be dimensionally stable.

2.1.3.2 Carriers

Provide carriers to support each louver made of molded plastic to transverse on self-fabricated wheels for smooth, easy operation. The hook of the carrier must have an automatic latch to permit easy installation and removal of the louver, and to securely lock the louver for tilting and
traversing.

2.1.3.3 Headrail System

Provide headrail system not less than 1.19 mm thick and made of anodized aluminum alloy or 0.635 mm thick phosphate treated steel with a baked on ivory gloss enamel paint finish. Provide a headrail that extends the full width of the blind and can be closed with an end cap at each end. One cap will contain the traversing and tilting controls. The opposite cap will house the pulley for the traversing cord.

2.1.3.4 Valance

Attach the manufacturer's standard valance to the headrail by metal or plastic holders which grip the top and bottom edge of the valance and accept an insert of the same material as the slats. Provide sufficient clearance behind the valance to permit the louvers to tilt without interference. Extend the headrail cover the full width of the blind.[Provide returns].

2.1.3.5 Controls

Provide tilting and traversing controls that hang compactly at the side of the blinds and reach within 1500 mm of the floor. Provide [tilt/traverse control][bead chain tilting control] that tilts all vanes simultaneously to any desired angle and hold them at that angle. Provide louvers that traverse [one way to the right] [one way to the left] [two-way split].[The traversing control cord will be minimum 1.78 mm in diameter with a minimum breaking strength of 556 N. Anchor the cord to a lead carrier linked to all adjacent carriers.] Provide louvers that traverse along the headrail by pulling one side of the looped cord [fastened to a cord tension pulley][ or ][a fiberglass wand that tilts the louvers by turning the wand and traverses the louvers by using the wand as a control]. Sliding glass doors will have a one way draw with stackback occurring opposite door openings.

2.1.3.6 Connectors and Spacers

The connector must be flexible, smooth and flat to slide unhindered when carriers move independently of each other, and to nest compactly when carriers are stacking. Relate the length of the links to the louver width in order to equally space the traversing louvers, to maintain uniform and adequate overlap of louvers, and to fully cover the width of the opening.

2.1.3.7 Intermediate Brackets

Provide intermediate installation brackets for blinds over 1575 mm wide.

2.2 COLOR

Provide color, pattern and texture [in accordance with Section 09 06 00 SCHEDULES FOR FINISHES][as indicated][selected from manufacturer's standard colors][[______]. Color listed is not intended to limit the selection of equal colors from other manufacturers.]
PART 3   EXECUTION

3.1   EXAMINATION

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2   WINDOW TREATMENT PLACEMENT SCHEDULE

[All exterior windows include [____].] [Provide window covering as follows:

<table>
<thead>
<tr>
<th>Room Number/Name</th>
<th>Window Covering Type</th>
<th>Vertical Blind Draw Direction</th>
<th>Window Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>[____]</td>
<td>[____]</td>
<td>[____]</td>
<td>[____]</td>
<td>[____]</td>
</tr>
</tbody>
</table>

]

3.3   INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Submit drawings showing fabrication and Installation details. Show layout and locations of track, direction of draw, mounting heights, and details. Provide Manufacturer's Instructions and Operation and Maintenance Data. Perform installation of window blinds in accordance with the approved detail drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.4   CLEAN-UP

Upon completion of the installation, inspect window treatments for soiling, damage or blemishes; and adjust them for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure blinds installed in recessed pockets can be removable without disturbing the pocket. The entire blind, when retracted, must be contained behind the pocket. For blinds installed outside the jambs and mullions, overlap each jamb and mullion 20 mm or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --
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      1.2.1.2 Basis for Calculations
      1.2.1.3 Hydraulic Calculations
   1.2.2 Sprinkler Coverage
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE
   1.4.1 Quality Control Fire Protection Engineer
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2.6 ALARM CHECK VALVE ASSEMBLY
2.7 WATERFLOW ALARM
2.8 ALARM INITIATING AND SUPERVISORY DEVICES
   2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type
   2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch
   2.8.3 Valve Supervisory (Tamper) Switch
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   2.10.2 Recessed Sprinkler
   2.10.3 Flush Sprinkler
   2.10.4 Pendent Sprinkler
   2.10.5 Upright Sprinkler
   2.10.6 Sidewall Sprinkler
   2.10.7 Residential Sprinkler
   2.10.8 Intermediate Level Rack Sprinkler
   2.10.9 Corrosion Resistant Sprinkler
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2.11 ACCESSORIES
   2.11.1 Sprinkler Cabinet
   2.11.2 Pendent Sprinkler Escutcheon
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2.12 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

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3.3 INSPECTION BY FIRE PROTECTION SPECIALIST
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   3.4.1 Protection of Piping Against Earthquake Damage
   3.4.2 Piping in Exposed Areas
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   3.4.12 Installation of Fire Department Connection
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3.6 ELECTRICAL WORK
3.7 PIPE COLOR CODE MARKING
3.8 PRELIMINARY TESTS
   3.8.1 Underground Piping
      3.8.1.1 Flushing
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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015  (2011) Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies - (ANSI approved 2010)

AMERICAN WATER WORKS ASSOCIATION (AWWA)


ASME INTERNATIONAL (ASME)

ASME B16.21  (2016) Nonmetallic Flat Gaskets for Pipe Flanges

ASTM INTERNATIONAL (ASTM)


ASTM F436M  (2011) Hardened Steel Washers (Metric)

FM GLOBAL (FM)


MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-71  (2011; Errata 2013) Gray Iron Swing Check Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101  (2018; TIA 18-1; TIA 18-2; TIA 18-3) Life Safety Code

NFPA 13  (2016; TIA 16-1; TIA 16-2; TIA 16-3 2016; Errata 17-1; Errata 17-2) Standard for the Installation of Sprinkler Systems

NFPA 13R  (2013) Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height


NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)


U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04  (2013; with Change 1, 2016) Seismic Design of Buildings
1.2 SYSTEM DESCRIPTION

Furnish piping offsets, fittings, and any other accessories as required to provide a complete installation and to eliminate interference with other construction. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage. Provide wet pipe sprinkler system in [all areas of the building] [areas indicated on the drawings] [______]. Except as modified herein, the system shall be designed and installed in accordance with [NFPA 13] [NFPA 13R]. Rack sprinklers shall be in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. Design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

1.2.1 Hydraulic Design

Hydraulically design the system to discharge a minimum density of [_____] L/min per square meter over the hydraulically most demanding [280] [_____] square m of floor area. The minimum pipe size for branch lines in gridded systems shall be 32 mm. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 6 m/s.

1.2.1.1 Hose Demand

Add an allowance for exterior hose streams of [_____] L/min to the sprinkler system demand [at the fire hydrant shown on the drawings closest to the point where the water service enters the building] [at the point of
connection to the existing system]. An allowance for interior hose stations of [_____]L/min shall also be added to the sprinkler system demand.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of [_____], and a flow of [_____] at a residual pressure of [______]. Water supply shall be presumed available [at the point of connection to existing] [at the base of the riser] [______]. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and [100] [_____] for existing underground piping. Hydraulic calculations shall be based on operation of the fire pump(s) provided in Section 21 30 00 FIRE PUMPS.

1.2.1.3 Hydraulic Calculations

Submit hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments and as outlined in NFPA 13, except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings to substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. Provide a summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. Indicate the diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 9 square m for extra hazard occupancies, 12 square m for ordinary hazard occupancies, and 21 square m for light hazard occupancies. Exceptions are as follows:

a. Facilities that are designed in accordance with NFPA 13R.

b. Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G[, [_____]]
As-Built Drawings

SD-03 Product Data

Fire Protection Related Submittals
Materials and Equipment; G[, [_____]]
Spare Parts
Preliminary Tests; G[, [_____]]
Final Acceptance Test; G[, [_____]]
Onsite Training; G[, [_____]]
Fire Protection Specialist; G[, [_____]]
Sprinkler System Installer; G[, [_____]]

SD-05 Design Data

Sway Bracing; G[, G[_____]]
Hydraulic Calculations; G[, G[_____]]

SD-06 Test Reports

Preliminary Test Report
Final Acceptance Test Report

SD-07 Certificates

Inspection by Fire Protection Specialist

SD-10 Operation and Maintenance Data

Operating and Maintenance Manuals; G[, G[_____]]

1.4 QUALITY ASSURANCE

Compliance with referenced NFPA standards is mandatory. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Interpret reference to "authority having jurisdiction" to mean the Contracting Officer.

1.4.1 Quality Control Fire Protection Engineer

A QFPE (Quality Control Fire Protection Engineer) shall be an individual who is a registered professional engineering who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCESES). The role of the QFPE shall be to review and approve the construction drawings,
calculations, material data sheets and must monitor the installation of the fire protection systems and certify in writing that the fire protection systems have been constructed and operate as intended in the design plans and specifications.

[The QFPE must review the shop drawings, hydraulic calculations and material submittals. The shop drawings must bear the Review Stamp of the QFPE prior to submitting the fire extinguishing system shop drawings to the DFPE.][Construction (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations and material data sheets, indicating approval prior to submitting the fire extinguishing system shop drawings to the DFPE.]

1.4.2 Fire Protection Specialist

[Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is certified as a Level [III] [IV] Technician by National Institute for Certification in Engineering Technologies (NICET) in the [Automatic Sprinkler System] [Special Hazards Suppression System] Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.]

[Perform work specified in this section under the supervision of or prepared by the by fire protection specialist who is the QFPE as stated in paragraph 1.4.2.]

Submit the name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days [_____] after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations. The Fire Protection Specialist shall prepare and submit a list of the fire protection related submittals, no later than [7] [_____] days after the approval of the Fire Protection Specialist, from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the QFPE (Quality Control Fire Protection Engineer) submitted to the Government. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.4.3 Sprinkler System Installer

Work specified in this section shall be performed by the Sprinkler System Installer who is regularly engaged in the installation of the type and complexity of system specified in the contract documents, and who has served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months. Submit the name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

1.4.4 Shop Drawings

Shop Drawings shall conform to the requirements established for working
plans as prescribed in NFPA 13. Submit [3] [_____] copies of the Sprinkler System shop drawings, no later than [21] [_____] days prior to the start of sprinkler system installation. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring. Submit load calculations for sizing of sway bracing, for systems that are required to be protected against damage from earthquakes.

1.5 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least
2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Provide Materials and Equipment that have been tested by Underwriters Laboratories, Inc. and are listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE. Submit manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, provide a complete equipment list that includes equipment description, model number and quantity.

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from a point 150 mm above the floor to [a point 1500 mm outside the building wall] [the point of connection to the existing water mains] shall be ductile iron with a rated working pressure of [1034] [1207] [_____] kPa conforming to AWWA C151/A21.51, with cement mortar lining conforming to AWWA C104/A21.4. Piping more than 1500 mm outside the building walls shall comply with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 900 mm above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM APP GUIDE.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel.

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of JIS G 3452, or JIS G 3452. Pipe in which threads or grooves are cut or rolled formed shall be Schedule
40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut or rolled formed. Pipe shall be marked with the name of the manufacturer, kind of pipe, and JIS designation. Flexible Sprinkler Hoses shall not be permitted. All steel piping shall be rigid.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to, steel conforming to JIS B 2301 or JIS B 2311, or, or malleable iron conforming to or JIS B 2301. [Steel press fittings shall be approved for fire protection systems.] Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used. Mechanical Tees fittings shall not be permitted.

2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to, Grade 32510; ductile iron conforming to JIS G 3452, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm thick, and full face or self-centering flat ring type.

2.5.1.5 Bolts, Nut, and Washers

Bolts shall be conform to ASTM A449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be [hexagon type conforming to ASME B18.2.2] [ASTM A193/A193M, Grade 5] [ASTM A563M, Grade [C3] [DH3]]. Washers shall meet the requirements of ASTM F436M. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM APP GUIDE and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.3 Valves

2.5.3.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM APP GUIDE.
2.5.3.2 Check Valve

Check valve 50 mm and larger shall be listed in UL Bld Mat Dir or FM APP GUIDE. Check valves 100 mm and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.3.3 Hose Valve

Valve shall comply with UL 668 and shall have a minimum rating of 2070 kPa. Valve shall be non-rising stem, all bronze, 90 degree angle type, with 65 mm American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 65 to 40 mm reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall be [polished brass] [rough chrome plated] [polished chrome plated].

2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

2.7 WATERFLOW ALARM

[Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel (FACP) in accordance with Section [28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP] [28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE]]. [Mechanically operated, exterior-mounted, water motor alarm assembly shall be provided and installed in accordance with NFPA 13. Water motor alarm assembly shall include a body housing, impeller or pelton wheel, drive shaft, striker assembly, gong, wall plate and related components necessary for complete operation. Minimum 19 mm galvanized piping shall be provided between the housing and the alarm check valve. Drain piping from the body housing shall be minimum 25 mm galvanized and shall be arranged to drain to the outside of the building. Piping shall be galvanized both on the inside and outside surfaces.]

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 38 L/min or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.
2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 13 mm NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa. There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be [projecting] [flush] type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a [polished brass] [chromium plated] finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm diameter American National Fire Hose Connection Screw Threads (NH) per [NFPA 1963] [____].

2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be [ordinary] [intermediate] [____] [as indicated]. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

2.10.1 Concealed Sprinkler

Concealed sprinkler shall be [chrome-plated] [stainless steel] [white polyester] [quick-response type] [____] and shall have a nominal 13 mm or 13.5 mm orifice.

2.10.2 Recessed Sprinkler

Recessed sprinkler shall be [chrome-plated] [stainless steel] [white polyester] [quick-response type] [____] and shall have a nominal 13 mm or 13.5 mm orifice.

2.10.3 Flush Sprinkler

Flush sprinkler shall be [chrome-plated] [stainless steel] [white polyester] [quick-response type] [____] and shall have a nominal 13 mm or 13.5 mm orifice.

2.10.4 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, [recessed] [quick-response] type with nominal 13 mm or 13.5 mm orifice. Pendent sprinklers shall have a [polished chrome] [stainless steel] [white polyester] [____] finish.
2.10.5 Upright Sprinkler

Upright sprinkler shall be [brass] [chrome-plated] [stainless steel] [white polyester] [quick-response type] [_____] and shall have a nominal 13 mm or 13.5 mm orifice.

2.10.6 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 13 mm orifice. Sidewall sprinkler shall have a [brass] [polished chrome] [stainless steel] [white polyester] [_____] finish. Sidewall sprinkler shall be the quick-response type.

2.10.7 Residential Sprinkler

Residential sprinkler shall be the [pendent] [and] [sidewall] type with nominal 13 mm orifice. Residential sprinkler shall have a [polished chrome] [white polyester] [_____] finish.

2.10.8 Intermediate Level Rack Sprinkler

Intermediate level rack sprinkler shall be of the upright or pendent type with nominal 13 mm orifice and minimum "K" factor of 5.5. The sprinkler shall be equipped with a deflector plate to shield the fusible element from water discharged above it.

2.10.9 Corrosion Resistant Sprinkler

Corrosion resistant sprinkler shall be the [upright] [pendent] type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.10.10 Dry Sprinkler Assembly

Dry sprinkler assembly shall be of the [pendent,] [upright,] [sidewall,] [45-degree] type as indicated. Assembly shall include an integral escutcheon. Maximum length shall not exceed maximum indicated in UL Fire Prot Dir. Sprinklers shall have a [polished chrome] [polyester coating] [or] [white enamel] finish.

2.11 ACCESSORIES

2.11.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.11.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 19 mm and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.11.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or
2.11.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located [_____] [as indicated].

2.11.5 Identification Sign

Valve identification sign shall be minimum 150 mm wide by 50 mm high with enamel baked finish on minimum 1.214 mm steel or 0.6 mm aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.12 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of [1034] [1207] [_____] kPa The maximum pressure loss shall be 4028 kPa at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 13.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

Prior to ceiling installation and concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports. The Fire Protection Specialist and QFPE shall: 1) inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.
3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Protection of Piping Against Earthquake Damage

Seismically protect the system piping against damage from earthquakes. This requirement is not subject to determination under NFPA 13. Install the seismic protection of the system piping in accordance with UFC 3-310-04, NFPA 13 and Annex A. Include the required features identified therein that are applicable to the specific piping system.

3.4.2 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 25 mm pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 300 mm for steel pipe or 150 mm for copper tubing. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 100 mm. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area. Pendent sprinklers in suspended ceilings shall be a minimum of 150 mm from ceiling grid.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm in length shall be individually supported.

3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and
grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 13 mm.

3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07 84 00 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 25 mm pipe connected [to the remote branch line] [at the riser as a combination test and drain valve]; a test valve located approximately 2 m above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.
3.4.11 Drains

Main drain piping shall be provided to discharge [at a safe point outside the building] [at the location indicated]. Auxiliary drains shall be provided as required by NFPA 13.

3.4.12 Installation of Fire Department Connection

Connection shall be mounted [on the exterior wall approximately 900 mm above finished grade] [adjacent to and on the sprinkler system side of the backflow preventer]. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be [900] [_____] mm. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm outside the building walls shall meet the requirements of Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

3.6 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. [Alarm signal wiring connected to the building fire alarm control system shall be in accordance with [Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP] [and] [Section 28 31 64.00 10 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.] [All wiring for supervisory and alarm circuits shall be [#14] [#16] AWG solid copper installed in metallic tubing or conduit.] Wiring color code shall remain uniform throughout the system.

3.7 PIPE COLOR CODE MARKING

Color code mark piping as specified in Section 09 90 00 PAINTS AND COATINGS.

3.8 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested and witnessed by the QFPETO to assure that equipment and components function as intended. Submit proposed procedures for Preliminary Tests, no later than [14] [_____] days prior to
the proposed start of the tests and proposed date and time to begin the preliminary tests. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, submit [3] copies of the completed Preliminary Test Report, no later than [7] days after the completion of the Tests. The Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

3.8.1 Underground Piping

3.8.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less that the calculated maximum water demand rate of the system.

3.8.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 1.89 L per hour per 100 gaskets or joints, regardless of pipe diameter.

3.8.2 Aboveground Piping

3.8.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa or 350 kPa in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.8.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. Provide all equipment and instruments necessary to conduct a complete forward flow test, including 65 mm diameter hoses, playpipe nozzles, calibrated pressure gauges, pitot tube gauge, plus all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. Provide a metal placard on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

3.8.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.
3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.9 FINAL ACCEPTANCE TEST

Begin the Final Acceptance Test only when the Preliminary Test Report has been approved. Submit proposed procedures for Final Acceptance Test, no later than [14] [_____] days prior to the proposed start of the tests, and proposed date and time to begin the Test, submitted with the procedures. Notification shall be provided at least [14] [_____] days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates. The Fire Protection Specialist and QFPE shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated水流 alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Submit as-built shop drawings, at least [14] [_____] days after completion of the Final Tests, updated to reflect as-built conditions after all related work is completed. Drawings shall be on reproducible full-size mylar film. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. Submit [3] [_____] copies of the completed Final Acceptance Test Report no later than [7] [_____] days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist as specified.

3.10 ONSITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit proposed schedule, at least 14 [_____] days prior to the start of related training. Training shall be provided for a period of 4 [_____] hours of normal working time and shall start after the system is functionally complete and after the Final Acceptance Test. Submit [6] [_____] Operating and Maintenance Manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days [_____] prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. [Each service organization submitted shall be capable of providing [4] [_____] hour on-site response to a service call on an emergency basis.] The Onsite Training shall cover all of the items contained in the approved manuals.

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PART 1  GENERAL

1.1  SUMMARY

Except as modified in this Section or on the drawings, install fire pumps in conformance with NFPA 20, NFPA 70, and NFPA 72. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification governs. Devices and equipment for fire protection service must be UL Fire Prot Dir listed or FM APP GUIDE approved. Interpret all reference to the authority having jurisdiction to mean the Contracting Officer.

1.2  SEQUENCING

1.2.1  Primary Fire Pump

Primary fire pump shall [automatically operate when the pressure drops to [758][_____] kPa] [automatically upon tripping of the [_____] sprinkler system[, [and][or] manually when the starter is operated]. [Pump[s] shall continue to run until shut down manually.] [Pump[s] shall automatically shut down after a running time of [_____] minutes unless manually shutdown.] The fire pump shall automatically stop operating when the system pressure reaches [862][_____] kPa and after the fire pump has operated for the minimum pump run time specified herein.

1.2.2  Secondary Fire Pump

Secondary fire pump shall operate at 69 kPa increments, set below the primary fire pump starting pressure. The fire pump shall automatically stop running at [862][_____] kPa and after the fire pump has operated for the minimum pump run time. Fire pumps shall be prevented from starting simultaneously and shall start sequentially at intervals of 5 to 10 seconds.

1.2.3  Pressure Maintenance Pump

Pressure maintenance pump shall operate when the system pressure drops to [793][_____] kPa. Pump shall automatically stop when the system pressure reaches [862][_____] kPa and after the pump has operated for the minimum pump run time specified herein.

1.3  FIRE PUMP INSTALLATION RELATED SUBMITTALS

[Perform work specified in this section under the supervision of and certified by the Fire Protection Specialist who is certified as a Level [III] [IV] Technician by National Institute for Certification in Engineering Technologies (NICET) in the [Automatic Sprinkler System] [Special Hazards Suppression System] Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7.]
Perform work specified in this section under the supervision of or prepared by the fire protection specialist who is the QFPE as stated in paragraph 1.7.1.

The Fire Protection Specialist shall prepare a list of the submittals, from the Contract Submittal Register, that relate to the successful installation of the fire pump(s), no later than [7] [_____] days after the approval of the Fire Protection Specialist and the Manufacturer's Representative. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084 (2005) Standard Methods for the Examination of Water and Wastewater

AWWA B300 (2010; Addenda 2011) Hypochlorites

AWWA B301 (2010) Liquid Chlorine


AWWA C500 (2009) Metal-Seated Gate Valves for Water Supply Service

AWWA C606 (2015) Grooved and Shouldered Joints

ASME INTERNATIONAL (ASME)

ASME B16.11 (2016) Forged Fittings, Socket-Welding and Threaded

ASME B16.18 (2018) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21 (2016) Nonmetallic Flat Gaskets for Pipe Flanges

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ASTM INTERNATIONAL (ASTM)

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<td>Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both</td>
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<td>(2011) Hardened Steel Washers (Metric)</td>
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**FM GLOBAL (FM)**

**FM APP GUIDE**

(Updated on-line) Approval Guide

http://www.approvalguide.com/

**MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)**

| MSS SP-80 | (2013) Bronze Gate, Globe, Angle and Check Valves |

**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

| NEMA MG 1 | (2016; SUPP 2016) Motors and Generators |

**NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.]
Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

**SD-01** Preconstruction Submittals

Fire Pump Installation Related Submittals

Fire Protection Specialist; G[, [_____]]

No later than [14] [_____] days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

**SD-02** Shop Drawings

Installation Drawings; G[, [_____]]

[3] [_____] copies

As-Built Drawings; G[, [_____]]

Piping Layout; G[, [_____]]

Pump Room; G[, [_____]]

**SD-03** Product Data

Catalog Data; G[, [_____]]

Spare Parts

Preliminary Tests

At least [14] [_____] days prior to the proposed date and time to begin Preliminary Tests

Field Tests; G[, [_____]]

At least 2 weeks before starting field tests

Manufacturer's Representative; G[, [_____]]

Field Training; G[, [_____]]

Final Acceptance Test

**SD-06** Test Reports

Preliminary Tests


**SD-07** Certificates

Fire Protection Specialist
No later than [14] [_____] days after the Notice to Proceed and prior to the submittal of the fire pump installation drawings

Qualifications of Welders

Qualifications of Installer

Preliminary Test Certification

Final Test Certification

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; G[, [____]]

At least [14] [_____] days prior to conducting field training

Flow Meter

Submit Data Package 2 for flow meter and controllers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6 EXTRA MATERIALS

Submit Spare Parts data for each different item of equipment and material specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Include a list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

1.7 QUALITY ASSURANCE

1.7.1 Quality Control Fire Protection Engineer

A QFPE (Quality Control Fire Protection Engineer) shall be an individual who is a registered professional engineering who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES). The role of the QFPE shall be to review and approve the construction drawings, calculations, material data sheets and must monitor the installation of the fire protection systems and certify in writing that the fire protection systems have been constructed and operate as intended in the design plans and specifications.

[The QFPE must review the shop drawings, hydraulic calculations and material submittals. The shop drawings must bear the Review Stamp of the QFPE prior to submitting the fire extinguishing system shop drawings to the DFPE.][Construction (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations and material data sheets, indicating approval prior to submitting the fire extinguishing system shop drawings to the DFPE.]
1.7.2 Fire Protection Specialist

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. Submit the name and documentation of certification of the proposed Fire Protection Specialists. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level IV Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.7.3 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

1.7.4 Qualifications of Installer

Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

1.7.5 Preliminary Test Certification

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.7.6 Final Test Certification

Concurrent with the Final Acceptance Test Report, submit certification by the Fire Protection Specialist that the fire pump installation is in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.[ Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.]

1.7.7 Manufacturer's Representative

Work specified in this section shall be performed under the supervision of and certified by a representative of the fire pump manufacturer. Submit the name and documentation of certification of the proposed Manufacturer's Representative, concurrent with submittal of the Fire Protection Specialist Qualifications. The Manufacturer's Representative shall be regularly engaged in the installation of the type and complexity of fire pump(s) specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner
intended for a period of not less than 6 months.

1.8 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, excessive humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall be either capped or plugged until installed.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

b. Submit manufacturer's catalog data included with the Fire Pump Installation Drawings for each separate piece of equipment proposed for use in the system. Catalog data shall indicate the name of the manufacturer of each item of equipment, with data annotated to indicate model to be provided. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided. Catalog data for material and equipment shall include, but not be limited to, the following:

(1) Fire pumps, drivers and controllers including manufacturer's certified shop test characteristic curve for each pump. Shop test curve may be submitted after approval of catalog data but shall be submitted prior to the final tests.

(2) Pressure maintenance pump and controller.

(3) Piping components.

(4) Valves, including gate, check, globe and relief valves.

(5) Gauges.

(6) Hose valve manifold test header and hose valves.

(7) Flow meter.

(8) Restrictive orifice union.

(9) Associated devices and equipment.

c. All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, [contract number and accepted date; capacity or size; system in which installed and system which it controls] and catalog number. Pumps and motors shall have standard nameplates securely affixed in a conspicuous place and easy to read. Fire pump shall have nameplates and markings in accordance with UL 448. Diesel driver shall have nameplate and markings in accordance with UL 1247. Electric motor nameplates shall provide the minimum information required by NFPA 70, Section 430-7.
2.2 FIRE PUMP

Fire pump shall be [electric motor driven] [diesel engine driven]. Each pump capacity shall be rated at [_____] L/second with a rated net pressure of [_____] kPa. Fire pump shall furnish not less than 150 percent of rated flow capacity at not less than 65 percent of rated net pressure. Pump shall be centrifugal [horizontal split case][water lubricated, vertical shaft turbine][end-suction][in-line] fire pump. Horizontal pump shall be equipped with automatic air release devices. The maximum rated pump speed shall be 2100 rpm when driving the pump at rated capacity. Pump shall be [automatic start and manual stop][manual pushbutton start and stop][automatic start and automatic stop]. Pump shall conform to the requirements of UL 448. Fire pump discharge and suction gauges shall be oil-filled type.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

2.3.1 General Requirements

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM APP GUIDE.

2.3.2 Alarms

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72 under Section [______]. Provide remote alarm devices located [at [______]][as indicated]. Alarm signal shall be activated upon the following conditions: [electric motor controller has operated into a pump running condition, loss of electrical power to electric motor starter, and phase reversal on line side of motor starter] [engine drive controller has operated into an engine running condition, engine drive controller main switch has been turned to OFF or to MANUAL position, trouble on engine driven controller or engine]. Exterior alarm devices shall be weatherproof type. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe and Fittings

Provide outside-coated, cement mortar-lined, ductile-iron pipe (with a rated working pressure of [1034][1207][_____] kPa) conforming to NFPA 24 for piping under the building and less than 1.50 m outside of the building walls. Anchor the joints in accordance with NFPA 24; provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size shall be 150 mm. Minimum depth of cover shall be as required by NFPA 24, but no less than 1 m. Piping more than 1.50 m outside of the building walls shall be [outside coated, AWWA C104/A21.4 cement mortar-lined, AWWA C151/A21.51 ductile-iron pipe, and AWWA C110/A21.10 fittings conforming to NFPA 24][provided under Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING].

SECTION 21 30 00 Page 13
2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110/A21.10. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111/A21.11.

2.4.3 Valves and Valve Boxes

Valves shall be gate valves conforming to AWWA C500 or UL 262. Valves shall have cast-iron body and bronze trim. Valve shall open by counterclockwise rotation. Except for post indicator valves, all underground valves shall be provided with an adjustable cast-iron or ductile iron valve box of a size suitable for the valve on which the box is to be used, but not less than 133 mm in diameter. The box shall be coated with bituminous coating. A cast-iron or ductile-iron cover with the word "WATER" cast on the cover shall be provided for each box.

2.4.4 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counterclockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 900 mm above finished grade. Gate valves and indicator posts shall be provided with one coat of primer and two coats of red enamel paint and shall be listed in UL Fire Prot Dir or FM APP GUIDE.

2.4.5 Buried Utility Warning and Identification Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping shall be provided for all buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be provided in rolls, 80 mm minimum width, color-coded for the utility involved and imprinted in bold black letters continuously and repeatedly over the entire tape length. Warning and identification shall be "CAUTION BURIED WATER PIPING BELOW" or similar wording. Code and lettering shall be permanent and unaffected by moisture and other substances contained in the trench backfill material. Tape shall be buried at a depth of 300 mm below the top surface of earth or the top surface of the subgrade under pavement.

2.5 ABOVEGROUND PIPING COMPONENTS

2.5.1 Pipe Sizes 65 mm and Larger

2.5.1.1 Pipe

Piping shall be [ASTM A53/A53M][ASTM A795/A795M], JIS G 3452, Weight Class STD (Standard), Schedule 40 (except for Schedule 30 for pipe sizes 200 mm and greater in diameter), Type E or Type S, Grade A; black steel pipe. Steel pipe shall be joined by means of flanges welded to the pipe or mechanical grooved joints only. Piping shall not be jointed by welding or weld fittings. Suction piping shall be galvanized on the inside in accordance with NFPA 20.

2.5.1.2 Flanges

Flanges shall be ASME B16.5, Class 150 flanges. Flanges shall be provided
at valves, connections to equipment, and where indicated.

2.5.1.3 Gaskets

Gaskets shall be AWWA C111/A21.11, cloth inserted red rubber gaskets.

2.5.1.4 Bolts

Bolts shall be [ASTM A449, Type [1][2]][ASTM A193/A193M, Grade B7]. Bolts shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

2.5.1.5 Nuts

Nuts shall be [ASTM A194/A194M, Grade 7][ASTM A193/A193M, Grade 5][ASTM A563M, Grade [C3][DH3]].

2.5.1.6 Washers

Washers shall meet the requirements of ASTM F436M. Flat circular washers shall be provided under all bolt heads and nuts.

2.5.2 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A47/A47M, JIS B 2301, JIS B 2311, Grade 32510; ductile iron conforming to ASTM A536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A183 and shall be cadmium plated or zinc electroplated. Mechanical tees shall not be permitted.

2.5.3 Piping Sizes 50 mm and Smaller

2.5.3.1 Steel Pipe

Steel piping shall be [ASTM A795/A795M][JIS G 3452, Weight Class STD (Standard), Schedule 40, Type E or Type S, Grade A][ASTM A53/A53M, Weight Class XS (Extra Strong)], zinc-coated steel pipe with threaded end connections. Fittings shall be [ASME B16.3][ASME B16.39, JIS B 2301, JIS B 2311], Class 150, zinc-coated threaded fittings. Unions shall be ASME B16.39, Class 150, zinc-coated unions.

2.5.3.2 Copper Tubing

Copper tubing shall be ASTM B88M, Type L or K, soft annealed. Fittings shall be ASME B16.26, flared joint fittings. Pipe nipples shall be ASTM B42 copper pipe with threaded end connections.

2.5.4 Pipe Hangers and Supports

Pipe hangers and support shall be [MSS SP-58][UL listed UL Fire Prot Dir or FM approved FM APP GUIDE] and shall be the adjustable type. Finish of rods, nuts, washers, hangers, and supports shall be zinc-plated after fabrication.
2.5.5 Valves

Valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire protection service. Valves shall have flange or threaded end connections.

2.5.5.1 Gate Valves and Control Valves

Gate valves and control valves shall be outside screw and yoke (O.S.&Y.) type which open by counterclockwise rotation. Butterfly-type control valves are not permitted.

2.5.5.2 Tamper Switch

The suction control valves, the discharge control valves, valves to test header and flow meter, and the by-pass control valves shall be equipped with valve tamper switches for monitoring by the fire alarm system.

2.5.5.3 Check Valve

Check valve shall be clear open, swing type check valve with flange or threaded inspection plate.

2.5.5.4 Relief Valve

Relief valve shall be [pilot operated][ or ][spring operated] type conforming to NFPA 20. A means of detecting water motion in the relief lines shall be provided where the discharge is not visible within the pump house.

2.5.5.5 Circulating Relief Valve

An adjustable circulating relief valve shall be provided for each fire pump in accordance with NFPA 20.

2.5.5.6 Suction Pressure Regulating Valve

Suction pressure regulating valve shall be FM approved FM APP GUIDE. Suction pressure shall be monitored through a pressure line to the controlling mechanism of the regulating valve. Valve shall be arranged in accordance with the manufacturer's recommendations.

2.5.6 Hose Valve Manifold Test Header

Construct header of steel pipe. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 65 mm National Standard male hose threads with cap and chain; locate one meter above grade in the horizontal position for each test header outlet. Welding shall be metallic arc process in accordance with ASME B31.1.

2.5.7 Pipe Sleeves

A pipe sleeve shall be provided at each location where piping passes entirely through walls, ceilings, roofs, and floors, including pipe entering buildings from the exterior. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide 25 mm minimum clearance between exterior of piping or pipe insulation, and
interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, a fire seal shall be provided between the pipe and the sleeve in accordance with Section 07 84 00 FIRESTOPPING.

a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide galvanized steel sheet pipe not less than 4.4 kg/square m.

2.5.8 Escutcheon Plates

Provide one-piece or split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Plates shall be secured in place.

2.6 DISINFECTING MATERIALS

2.6.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.6.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.7 ELECTRIC MOTOR DRIVER

Motors, controllers, contactors, and disconnects shall be provided with their respective pieces of equipment, as specified herein and shall have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Controllers and contactors shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section. Motor shall conform to NEMA MG 1 Design B type. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Motor wattage shall be of sufficient size so that the nameplate wattage rating will not be exceeded throughout the entire published pump characteristic curve. The motor and fire pump controller shall be fully compatible.

2.8 DIESEL ENGINE DRIVER

Diesel engine driver shall conform to the requirements of UL 1247 and shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Driver shall be of the make recommended by the pump manufacturer. The engine shall be closed circuit, liquid-cooled [with raw water heat exchanger][with radiator and engine-driven fan]. Diesel engine shall be electric start type taking current from 2 battery units. Engine
shall be equipped with a fuel in-line filter-water separator. Engine conditions shall be monitored with engine instrumentation panel that has a tachometer, hour meter, fuel pressure gauge, lubricating oil pressure gauge, water temperature gauge, and ammeter gauge. Engine shall be connected to horizontal-shaft pump by flexible couplings. For connections to vertical-shaft fire pumps, right-angle gear drives and universal joints shall be used. An engine jacket water heater shall be provided to maintain a temperature of 49 degrees C in accordance with NFPA 20.

2.8.1 Engine Capacity

Engine shall have adequate wattage to drive the pump at all conditions of speed and load over the full range of the pump performance curve. The wattage rating of the engine driver shall be as recommended by the pump manufacturer and shall be derated for temperature and elevation in accordance with NFPA 20. Ambient temperature at the pump location shall be [_____] degrees C. Site elevation shall be [_____] meters above mean sea level (MSL).

2.8.2 Exhaust System External to Engine

Exhaust system shall comply with the requirements of NFPA 20 and NFPA 37. An exhaust muffler shall be provided for each diesel engine driver to reduce noise levels less than [85][95] dBA. A flexible connector with flange connections shall be provided at the engine. Flexible sections shall be stainless steel suitable for diesel-engines exhaust gas at 538 degrees C.

2.8.2.1 Steel Pipe and Fittings

ASTM A53/A53M, [Schedule 40][Weight Class XS (Extra Strong], black steel, welding end connections. ASME B16.9 or ASME B16.11 welding fittings shall be of the same material and weight as the piping.

2.8.2.2 Flanges

ASME B16.5, Class [300][150]. Flanges shall be provided at connections to diesel engines, exhaust mufflers, and flexible connections. Gaskets shall be ASME B16.21, composition ring, 1.5875 mm. ASTM A193/A193M, Grade [B8][B7] bolts and ASTM A194/A194M, Grade [8][7] nuts shall be provided.

2.8.2.3 Piping Insulation

Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING. Products containing asbestos will not be permitted. Exhaust piping system including the muffler shall be insulated with ASTM C533 calcium silicate insulation, minimum of 75 mm. Insulation shall be secured with not less than 9.525 mm width fibrous glass reinforced waterproof tape or Type 304 stainless steel bands spaced not more than 200 mm on center. An aluminum jacket encasing the insulation shall be provided. The aluminum jacket shall have a minimum thickness of 0.406 mm, a factory-applied polyethylene and kraft paper moisture barrier on the inside surface. The jacket shall be secured with not less than 13 mm wide stainless steel bands, spaced not less than 200 mm on centers. Longitudinal and circumferential seams of the jacket shall be lapped not less than 75 mm. Jackets on horizontal line shall be installed so that the longitudinal seams are on the bottom side of the pipe. The seams of the jacket for the vertical lines shall be placed on the off-weather side of the pipe. On vertical lines, the circumferential seams of the jacket shall
overlap so the lower edge of each jacket overlaps the upper edge of the jacket below.

2.9  FIRE PUMP CONTROLLER

Controller shall be the automatic type and UL listed UL Fire Prot Dir or FM approved FM APP GUIDE for fire pump service. Pump shall be arranged for automatic start and stop, and manual push-button stop. Automatic stopping shall be accomplished only after all starting causes have returned to normal and after a minimum pump run time has elapsed. Controllers shall be completely terminally wired, ready for field connections, and mounted in a [NEMA Type 2 drip-proof][NEMA Type 4 watertight and dust tight] enclosure arranged so that controller current carrying parts will not be less than 300 mm above the floor. Controller shall be provided with voltage surge arresters installed in accordance with NFPA 20. Controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments, automatic starting relay actuated from normally closed contacts, visual alarm lamps and supervisory power light. Controller shall be equipped with a thermostat switch with adjustable setting to monitor the pump room temperature and to provide an alarm when temperatures falls below 5 degrees C. Controller shall be equipped with a sequential start timer/relay feature to start multiple fire pumps in sequence.[ The controller shall be factory-equipped with a heater operated by thermostat to prevent moisture in the cabinet.]

2.9.1  Controller for Electric Motor Driven Fire Pump

Controller shall be [electronic soft start][across the line][auto-transformer][wye-delta, open circuit transition][wye-delta, closed circuit transition] starting type. Controller shall be designed for [_____] kW at [_____] volts[as indicated]. Controller[ and transfer switch] shall have a short circuit rating [of [_____] amps r.m.s. symmetrical at [_____] volts a.c.][as indicated].[ An automatic transfer switch (ATS) shall be provided for each fire pump. The ATS shall comply with NFPA 20 and shall be specifically listed for fire pump service. The ATS shall transfer source of power to the alternate source upon loss of normal power.] Controller shall monitor pump running, loss of a phase or line power, phase reversal, low reservoir and pump room temperature. Alarms shall be individually displayed in front of panel by lighting of visual lamps. Each lamp shall be labeled with rigid etched plastic labels. Controller shall be equipped with terminals for remote monitoring of pump running, pump power supply trouble (loss of power or phase and phase reversal), and pump room trouble (pump room temperature [and low reservoir level]), and for remote start. Limited service fire pump controllers are not permitted, except for fire pumps driven by electric motors rated less than 11 kW. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour spring wound back-up. The pressure recorder shall provide a readout of the system pressure from 0 to 207 Pa, time, and date. Controller shall require the pumps to run for ten minutes for pumps with driver motors under 149 kW and for 15 minutes for pumps with motors 149 kW and greater, prior to automatic shutdown. The controller shall be equipped with an externally operable isolating switch which manually operates the motor circuit. Means shall be provided in the controller for measuring current for all motor circuit conductors.

2.9.2  Controller for Diesel Engine Driven Fire Pump

Controller shall require the pump to run for 30 minutes prior to automatic shutdown. Controller shall be equipped with two battery chargers; two
ammeters; two voltmeters, one for each set of batteries. Controller shall automatically alternate the battery sets for starting the pumps. Controller shall be equipped with the following supervisory alarm functions:

a. Engine Trouble (individually monitored)
   (1) Engine overspeed
   (2) Low Oil Pressure
   (3) High Water Temperature
   (4) Engine Failure to Start
   (5) Battery
   (6) Battery Charger/AC Power Failure

b. Main Switch Mis-set

c. Pump Running

d. Pump Room Trouble (individually monitored)
   (1) Low Fuel
   (2) Low Pump Room Temperature
   (3) Low Reservoir Level

Alarms shall be individually displayed in front of panel by lighting of visual lamps, except that individual lamps are not required for pump running and main switch mis-set. Controller shall be equipped with a 7-day electric pressure recorder with 24-hour back-up mounted inside the controller. The pressure recorder shall provide a readout of the system pressure from 0 to 207 Pa, time, and date. The controller shall be equipped with an audible alarm which will activate upon any engine trouble or pump room trouble alarm condition and alarm silence switch. Controller shall be equipped with terminals for field connection of a remote alarm for main switch mis-set, pump running, engine trouble and pump room trouble; and terminals for remote start. When engine emergency overspeed device operates, the controller shall cause the engine to shut down without time delay and lock out until manually reset.

2.10 BATTERIES

Batteries for diesel engine driver shall be sealed lead calcium batteries. Batteries shall be mounted in a steel rack with non-corrosive, non-conductive base, not less than 300 mm above the floor.

2.11 PRESSURE SENSING LINE

A completely separate pressure sensing line shall be provided for each fire pump and for the jockey pump. The sensing line shall be arranged in accordance with Figure A-7-5.2.1. of NFPA 20. The sensing line shall be 13 mmH58 brass tubing complying with ASTM B135M. The sensing line shall be equipped with two restrictive orifice unions each. Restricted orifice unions shall be ground-face unions with brass restricted diaphragms drilled for a 2.4 mm. Restricted orifice unions shall be mounted in the horizontal
position, not less than 1.5 m apart on the sensing line. Two test connections shall be provided for each sensing line. Test connections shall consist of two brass 13 mm globe valves and 8 mm gauge connection tee arranged in accordance with NFPA 20. One of the test connections shall be equipped with a 0 to 2100 kPa water oil-filled gauge. Sensing line shall be connected to the pump discharge piping between the discharge piping control valve and the check valve.

2.12 PRESSURE MAINTENANCE PUMP

2.12.1 General

Pressure maintenance pump shall be electric motor driven, horizontal shaft or in-line vertical shaft, centrifugal type with a rated discharge of [0.63][_____] L/second at [862][_____] kPa. Pump shall draft from the suction supply side of the suction pipe gate valve of the fire pump and shall discharge into the system at the downstream side of the pump discharge gate valve. An approved indicating gate valve of the outside screw and yoke (O.S.&Y.) type shall be provided in the maintenance pump discharge and suction piping. Oil-filled water pressure gauge and approved check valve in the maintenance pump discharge piping shall be provided. Check valve shall be swing type with removable inspection plate.

2.12.2 Pressure Maintenance Pump Controller

Pressure maintenance pump controller shall be arranged for automatic and manual starting and stopping and equipped with a "manual-off-automatic" switch. The controller shall be completely prewired, ready for field connections, and wall-mounted in a NEMA Type 2 drip-proof enclosure. The controller shall be equipped with a bourdon tube pressure switch or a solid state pressure switch with independent high and low adjustments for automatic starting and stopping. A sensing line shall be provided connected to the pressure maintenance pump discharge piping between the control valve and the check valve. The sensing line shall conform to paragraph, PRESSURE SENSING LINE. The sensing line shall be completely separate from the fire pump sensing lines. An adjustable run timer shall be provided to prevent frequent starting and stopping of the pump motor. The run timer shall be set for [2][_____] minutes.

2.13 DIESEL FUEL SYSTEM EXTERNAL TO ENGINE

Fuel system shall be provided that meets all requirements of NFPA 20 and NFPA 37. The fuel tank vent piping shall be equipped with screened weatherproof vent cap. Vents shall be extended to the outside. Each tank shall be equipped with a fuel level gauge. Flexible bronze or stainless steel piping connectors with single braid shall be provided at each piping connection to the diesel engine. Supply, return, and fill piping shall be steel piping, except supply and return piping may be copper tubing. Fuel lines shall be protected against mechanical damage. Fill line shall be equipped with 16 mesh removable wire screen. Fill lines shall be extended to the exterior. A weatherproof tank gauge shall be mounted on the exterior wall near each fill line for each tank. The fill cap shall be able to be locked by padlock. The engine supply (suction) connection shall be located on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. The elevation of the fuel tank shall be such that the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. The bottom of the tank shall be pitched 21 mm/m to the side opposite the suction inlet connection, and to an accessible 25 mm plugged
globe drain valve.

2.13.1 Fuel Piping

As specified in NFPA 20.

2.13.2 Diesel Fuel Tanks

UL 80 or UL 142 for aboveground tanks.

2.13.3 Valves

Provide an indicating and lockable ball valve in the supply line adjacent to the tank suction inlet connection. Provide a check valve in fuel return line. Valves must be suitable for oil service. Valves must have union end connections or threaded end connections.

2.13.3.1 Globe Valve

MSS SP-80 Class 125

2.13.3.2 Check Valve

MSS SP-80, Class 125, swing check

2.13.3.3 Ball Valve

Full port design, copper alloy body, 2-position lever handle

2.14 JOINTS AND FITTINGS FOR COPPER TUBE

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D2000 for circulating medium up to 110 degrees C. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A183.

2.15 PUMP BASE PLATE AND PAD

Provide a common base plate for each horizontal-shaft fire pump for mounting pump and driver unit. Construct the base plate of cast iron with raised lip tapped for drainage or welded steel shapes with suitable drainage. Provide each base plate for the horizontal fire pumps with a 25 mm galvanized steel drain line piped to the nearest floor drain. For vertical shaft pumps, pump head shall be provided with a cast-iron base plate and shall serve as the sole plate for mounting the discharge head assembly. Mount pump units and bases on a raised [100][150] mm reinforced concrete pad that is an integral part of the reinforced concrete floor.
2.16 HOSE VALVE MANIFOLD TEST HEADER

Hose valve test header shall be connected by ASME B16.5, Class 150 flange inlet connection. Hose valves shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE bronze hose gate valves with 65 mm American National Fire Hose Connection Screw Standard Threads (NH) in accordance with NFPA 1963. The number of valves shall be in accordance with NFPA 20. Each hose valve shall be equipped with a cap and chain, and located no more than 900 mm and no less than 600 mm above grade.

2.17 FLOW METER

Meter shall be UL listed UL Fire Prot Dir or FM approved FM APP GUIDE as flow meters for fire pump installation with direct flow readout device. Flow meter shall be capable of metering any flow quantities between 50 percent and 150 percent of the rated flow of the pumps. Arrange piping to permit flow meter to discharge to pump suction and to discharge through test header. The meter throttle valve and the meter control valves shall be O.S.&Y. valves. Provide automatic air release if flow meter piping between pump discharge and pump suction forms an inverted "U". Meter shall be of the [venturi][annular probe][orifice plate] type.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist and QFPEshall periodically perform a thorough inspection of the fire pump installation, including visual observation of the pump while running, to assure that the installation conforms to the contract requirements. There shall be no excessive vibration, leaks (oil or water), unusual noises, overheating, or other potential problems. Inspection shall include piping and equipment clearance, access, supports, and guards. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered. The Fire Protection Specialist and QFPE shall witness the preliminary and final acceptance tests and, after completion of the inspections and a successful final acceptance test, shall sign test results and certify in writing that the installation the fire pump installation is in accordance with the contract requirements.

3.3 INSTALLATION

Equipment, materials, workmanship, fabrication, assembly, erection, installation, examination, inspection and testing shall be in accordance NFPA 20, except as modified herein. In addition, the fire pump and engine shall be installed in accordance with the written instructions of the manufacturer.

3.3.1 Installation Drawings

Submit Fire Pump Installation Drawings consisting of a detailed plan view, detailed elevations and sections of the pump room, equipment and piping,
drawn to a scale of not less than 1:20. Drawings shall indicate equipment, piping, and associated pump equipment to scale. Indicate all clearance, such as those between piping and equipment; between equipment and walls, ceiling and floors; and for electrical working distance clearance around all electrical equipment. Include a legend identifying all symbols, nomenclatures, and abbreviations. Indicate a complete piping and equipment layout including elevations and/or section views of the following:

a. Fire pumps, controllers, piping, valves, and associated equipment.
b. Sensing line for each pump including the pressure maintenance pump.
c. Engine fuel system for diesel driven pumps.
d. Engine cooling system for diesel driven pumps.
e. Pipe hangers and sway bracing including support for diesel muffler and exhaust piping.
f. Restraint of underground water main at [entry-point][entry-and exit-points] to the building including details of pipe clamps, tie rods, mechanical retainer glands, and thrust blocks.
g. A one-line schematic diagram indicating layout and sizes of all piping, devices, valves and fittings.
h. A complete point-to-point connection drawing of the pump power, control and alarm systems, as well as interior wiring schematics of each controller.

3.3.2 Pump Room Configuration

Provide detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Submit working drawings on sheets not smaller than A1 594 by 841 mm; include data for the proper installation of each system. Show piping schematic of pumps, devices, valves, pipe, and fittings. [Provide an isometric drawing of the fire pump and all associated piping]. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Show engine fuel and cooling system. Include:

a. Pumps, drivers, and controllers
b. Hose valve manifold test header
c. Circuit diagrams for pumps
d. Wiring diagrams of each controller

3.3.3 Accessories

Tank supports, piping offsets, fittings, and any other accessories required shall be furnished as specified to provide a complete installation and to eliminate interference with other construction.

3.4 PIPE AND FITTINGS

Piping shall be inspected, tested and approved before burying, covering, or concealing. Fittings shall be provided for changes in direction of piping
and for all connections. Changes in piping sizes shall be made using
tapered reducing pipe fittings. Bushings shall not be used. [Photograph
all piping prior to burying, covering, or concealing.]

3.4.1 Cleaning of Piping

Interior and ends of piping shall be clean and free of any water or foreign
material. Piping shall be kept clean during installation by means of plugs
or other approved methods. When work is not in progress, open ends of the
piping shall be securely closed so that no water or foreign matter will
enter the pipes or fittings. Piping shall be inspected before placing in
position.

3.4.2 Threaded Connections

Jointing compound for pipe threads shall be [polytetrafluoroethylene (PTFE)
pipe thread tape conforming to ASTM D3308] [Teflon pipe thread paste] and
shall be applied to male threads only. Exposed ferrous pipe threads shall
be provided with one coat of zinc molybdate primer applied to a minimum of
dry film thickness of 0.025 mm.

3.4.3 Pipe Hangers and Supports

Additional hangers and supports shall be provided for concentrated loads in
aboveground piping, such as for valves and risers.

3.4.3.1 Vertical Piping

Piping shall be supported at each floor, at not more than 3 meters
intervals.

3.4.3.2 Horizontal Piping

Horizontal piping supports shall be spaced as follows:

<table>
<thead>
<tr>
<th>Nominal Pipe Size (mm)</th>
<th>25 and Under</th>
<th>32</th>
<th>40</th>
<th>50</th>
<th>65</th>
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<td>2.4</td>
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<td>2.4</td>
<td>2.7</td>
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<td>3.3</td>
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<td>3.9</td>
<td>4.2</td>
<td>4.8</td>
<td>5.0</td>
</tr>
</tbody>
</table>

3.4.4 Underground Piping

Installation of underground piping and fittings shall conform to NFPA 24.
Joints shall be anchored in accordance with NFPA 24. Concrete thrust block
shall be provided at elbow where pipe turns up towards floor, and the pipe
riser shall be restrained with steel rods from the elbow to the flange
above the floor. After installation in accordance with NFPA 24, rods and
nuts shall be thoroughly cleaned and coated with asphalt or other corrosion-retard material approved by the Contracting Officer. Minimum depth of cover shall be 900 mm.

3.4.5 Grooved Mechanical Joint

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.5 ELECTRICAL WORK

Electric motor and controls shall be in accordance with NFPA 20, NFPA 72 and NFPA 70, unless more stringent requirements are specified herein or are indicated on the drawings. Electrical wiring and associated equipment shall be provided in accordance with NFPA 20 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.6 PIPE COLOR CODE MARKING

Color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 FLUSHING

The fire pump suction and discharge piping shall be flushed at [120][150] percent of rated capacity of each pump. Where the pump installation consists of more than one pump, the flushing shall be the total quantity of water flowing when all pumps are discharging at [120][150] percent of their rated capacities. The new pumps may be used to attain the required flushing volume. No underground piping shall be flushed by using the fire pumps. Flushing operations shall continue until water is clear, but not less than 10 minutes. Submit a signed and dated flushing certificate before requesting field testing.

3.8 FIELD TESTS

Submit system diagrams that show the layout of equipment, piping, and storage units, and typed condensed sequence of operation, wiring and control diagrams, and operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.
3.8.1 Hydrostatic Test

Piping shall be hydrostatically tested at 1551 kPa for a period of 2 hours, or at least 345 kPa in excess of the maximum pressure, when the maximum pressure in the system is in excess of [1207][1379] kPa in accordance with NFPA 20.

3.8.2 Preliminary Tests

Submit proposed procedures for Preliminary Tests prior to the proposed date and time to begin Preliminary Tests. The Fire Protection Specialist and QFPE shall take all readings and measurements. The Manufacturer's Representative, a representative of the fire pump controller manufacturer, and a representative of the diesel engine manufacturer (when supplied) shall witness the complete operational testing of the fire pump and drivers. The fire pump controller manufacturer's representative and the diesel engine manufacturer's representative shall each be an experienced technician employed by the respective manufacturers and capable of demonstrating operation of all features of respective components including trouble alarms and operating features. Fire pumps, drivers and equipment shall be thoroughly inspected and tested to insure that the system is correct, complete, and ready for operation. Tests shall ensure that pumps are operating at rated capacity, pressure and speed. Tests shall include manual starting and running to ensure proper operation and to detect leakage or other abnormal conditions, flow testing, automatic start testing, testing of automatic settings, sequence of operation check, test of required accessories; test of pump alarms devices and supervisory signals, test of pump cooling, operational test of relief valves, and test of automatic power transfer, if provided. Pumps shall run without abnormal noise, vibration or heating. If any component or system was found to be defective, inoperative, or not in compliance with the contract requirements during the tests and inspection, the corrections shall be made and the entire preliminary test shall be repeated. Submit Preliminary Tests Reports, to include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Report shall be signed by the Fire Protection Specialist and the Manufacturer's Representative.

3.8.3 Final Acceptance Test

The Fire Protection Specialist and QFPE shall take all readings and measurements. The Manufacturer's Representative, the fire pump controller manufacturer's representative, and the diesel engine manufacturer's representative (when supplied) shall also witness for the final tests. Repair any damage caused by hose streams or other aspects of the test. Submit proposed date and time to begin Final Acceptance Test, with the Acceptance Procedures. Notification shall be provided at least [14] [_____] days prior to the proposed start of the test. Submit [3] [_____] copies of the completed Final Acceptance Test Reports, no later that [7] [_____] days after the completion of the tests. All items in the reports shall be signed by the Fire Protection Specialist, QFPE and the Manufacturer's Representative. Test reports in booklet form (each copy furnished in a properly labeled three ring binder) showing all field tests and measurements taken during the preliminary and final testing, and documentation that proves compliance with the specified performance criteria, upon completion of the installation and final testing of the installed system. Each test report shall indicate the final position of the controls and pressure switches. The test reports shall include the description of the hydrostatic test conducted on the piping and flushing of
the suction and discharge piping. A copy of the manufacturer's certified pump curve for each fire pump shall be included in the report. Notification shall include a copy of the Contractor's Material & Test Certificates. Include the following in the final acceptance test:

3.8.3.1 Flow Tests

Flow tests using the test header, hoses and playpipe nozzles shall be conducted. Flow tests shall be performed at churn (no flow), 75, 100, 125 and 150 percent capacity for each pump and at full capacity of the pump installation. Flow readings shall be taken from each nozzle by means of a calibrated pitot tube with gauge or other approved measuring equipment. Rpm, suction pressure and discharge pressure reading shall be taken as part of each flow test. Voltage and ampere readings shall taken on each phase as part of each flow test for electric-motor driven pumps.

3.8.3.2 Starting Tests

Pumps shall be tested for automatic starting and sequential starting. Setting of the pressure switches shall be tested when pumps are operated by pressure drop. Tests may be performed by operating the test connection on the pressure sensing lines. As a minimum, each pump shall be started automatically 10 times and manually 10 times, in accordance with NFPA 20. Tests of engine-driven pumps shall be divided equally between both set of batteries. The fire pumps shall be operated for a period of a least 10 minutes for each of the starts; except that electric motors over 149 kW shall be operated for at least 15 minutes and shall not be started more than 2 times in 10 hours. Pressure settings that include automatic starting and stopping of the fire pump(s) shall be indicated on an etched plastic placard, attached to the corresponding pump controller.

3.8.3.3 Battery Changeover

Diesel driven fire pumps shall be tested for automatic battery changeover in event of failure of initial battery units.

3.8.3.4 Alarms

All pump alarms, both local and remote, shall be tested. Supervisory alarms for diesel drivers shall be electrically tested for low oil pressure, high engine jacket coolant temperature, shutdown from overspeed, battery failure and battery charger failure.

3.8.3.5 Miscellaneous

Valve tamper switches shall be tested. Pressure recorder operation relief valve settings, valve operations, operation and accuracy of meters and gauges, and other accessory devices shall be verified.

3.8.3.6 Alternate Power Source

On installations with an alternate source of power and an automatic transfer switch, loss of primary power shall be simulated and transfer shall occur while the pump is operating at peak load. Transfer from normal to emergency source and retransfer from emergency to normal source shall not cause opening of overcurrent devices in either line. At least half of the manual and automatic starting operations listed shall be performed with the fire pump connected to the alternate source.
3.8.3.7 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests shall be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.8.3.8 Test Documentation

The Manufacturer's Representative shall supply a copy of the manufacturer's certified curve for each fire pump at the time of the test. The Fire Protection Specialist shall record all test results and plot curve of each pump performance during the test. Complete pump acceptance test data of each fire pump shall be recorded. The pump acceptance test data shall be on forms that give the detail pump information such as that which is indicated in Figure A-11-2.6.3(f) of NFPA 20. All test data records shall be submitted in a three ring binder.

3.8.4 Test Equipment

Provide all equipment and instruments necessary to conduct a complete final test, including 65 mm diameter hoses, playpipe nozzles, pitot tube gauges, portable digital tachometer, voltage and ampere meters, and calibrated oil-filled water pressure gauges. Provide all necessary supports to safely secure hoses and nozzles during the test. The [Government will][Contractor shall] furnish water for the tests.

3.9 DISINFECTION

After all system components are installed including pumps, piping, and other associated work, and all hydrostatic tests are successfully completed, thoroughly flush the pumps and all piping to be disinfected with potable water until there is no visible sign of dirt or other residue. and hydrostatic test are successfully completed, each portion of the piping specified in this Section system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material.

3.9.1 Chlorination

The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system if filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system.

3.9.2 Flushing

The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer.
3.9.3 Sample Testing

Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.10 SYSTEM STARTUP

Fully enclose or properly guard coupling, rotating parts, gears, projecting equipment, etc. so as to prevent possible injury to persons that come in close proximity of the equipment. Conduct testing of the fire pumps in a safe manner and ensure that all equipment is safely secured. Hoses and nozzles used to conduct flow tests shall be in excellent condition and shall be safely anchored and secured to prevent any misdirection of the hose streams.

Post operating instructions for pumps, drivers, controllers, and flow meters.

3.11 CLOSEOUT ACTIVITIES

3.11.1 Field Training

The Fire Protection Specialist and the Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Submit the proposed schedule for field training at least 14 days prior to the start of related training. Training shall be provided for a period of [2] [8] hours of normal working time and shall start after the fire pump installation is functionally complete and after the Final Acceptance Test. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions. Submit manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Data Package 3 shall be submitted for fire pumps and drivers in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. [Each service organization submitted shall be capable of providing [4] [_____] hour onsite response to a service call on an emergency basis.]

3.11.2 As-Built Drawings

Submit As-Built Drawings, no later than [14][_____] days after completion of the Final Tests. Update the Fire Pump Installation Drawings to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

3.12 PROTECTION

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by the Contractor's operations with
new work of the same construction.

-- End of Section --
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PART 1  GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man (2016) Firestopping: Plastic Pipe in Fire Resistant Construction

JAPAN WATER WORKS ASSOCIATION (JWWA)

JWWA K 115 (2018) Tar Epoxy Resin Paint of Water Works and Painting Method

JWWA K 120 (2008) Water Works Sodium Hypochlorite

JWWA K 144 (2017) Polyethylene Pipe for Water Distribution

JWWA K 145 (2017) Polyethylene Pipe Fitting for Water Distribution

JWWA S 101 (2019) Polyethylene Pipe Fitting for Water Distribution

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS A 4421 (1991) Drain With Traps for Equipment Units

JIS A 5207 (2014) Sanitary Wares

JIS A 5532 (2011) Bathtubs

JIS A 5758 (2016) Sealants for Sealing and Glazing in Buildings
Japan Edited Specifications
February 2020

JIS A 6005 (2005) Asphalt Roofing Felts

JIS B 0203 (1999) Taper Pipe Threads


JIS B 2004 (1994) General Rules for Marking on Valves

JIS B 2011 (2013) Bronze, Gate, Globe, Angle, and Check Valves (Amendment 2)

JIS B 2031 (2015) Gray Cast Iron Valves (Amendment 1)

JIS B 2061 (2017) Faucets, Ball Taps and Flush Valves

JIS B 2071 (2000) Steel Valves

JIS B 2220 (2012) Steel Pipe Flanges

JIS B 2240 (2006) Copper Alloy Pipe Flanges

JIS B 2301 (2013) Screwed Type Malleable Cast Iron Pipe Fittings

JIS B 2302 (2013) Screwed Type Steel Pipe Fittings

JIS B 2308 (2013) Stainless Steel Threaded Fittings

JIS B 2309 (2009) Butt-Welding Pipe Fittings for Light Gauge Stainless Steel Tubes for Ordinary Use

JIS B 2312 (2015) Steel Butt-Welding Pipe Fittings

JIS B 2316 (2017) Steel Socket-Welding Pipe Fittings


JIS B 7414 (2018) Glass Thermometers


JIS B 8285 (2010) Welding Procedure Qualification Test for Pressure Vessels


JIS B 8410 (2015) Pressure Reducing Valves for Water
Works

JIS B 8414  (2011) Relief Valves for Hot Water Appliances (Amendment 3)


JIS C 4212  (2010) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)


JIS C 9618  (1992) Drinking-Water Coolers

JIS G 3103  (2012) Carbon Steel and Molybdenum Alloy Steel Plates for Boilers and Pressure Vessels

JIS G 3118  (2017) Carbon Steel Plates for Pressure Vessels for Intermediate and Moderate Temperature Services

JIS G 3201  (2008) Carbon Steel Forgings for General Use (Amendment 1)

JIS G 3452  (2016) Carbon Steel Pipes for Ordinary Piping (Amendment 1)

JIS G 4051  (2018) Carbon Steels for Machine Structural Use (Amendment 1)

JIS G 4107  (2015) Alloy Steel Bolting Materials for High Temperature Service (Amendment 1)

JIS G 4303  (2012) Stainless Steel Bars


JIS G 5526  (2014) Ductile Iron Pipes


JIS H 3100  (2018) Copper and Copper Alloy Sheets, Plates and Strips

JIS H 3250  (2015) Copper and Copper Alloy Rods and Bars

JIS H 3300  (2018) Copper and Copper Alloy Seamless Pipes and Tubes

JIS H 3401  (2001) Pipe Fittings of Copper and Copper
Alloys

JIS H 5120 (2016) Copper and Copper Alloy Castings

JIS K 5981 (2006) Thermoplastic and Thermosetting Powder Coated Films

JIS K 6353 (2011) Rubber Goods for Water Works

JIS K 6739 (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipe Fittings for Drain

JIS K 6741 (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipes

JIS K 6742 (2016) Unplasticized poly (vinyl chloride) (PVC-U) pipes for water supply


JIS K 6761 (2017) Polyethylene Pipes for General Purposes


JIS K 6776 (2011) Chlorinated Poly (vinyl chloride) (PVC-C) Pipes for Hot and Cold Water Supply

JIS K 7013 (2009) Fibre Reinforced Plastic Pipes (Amendment 1)


JIS K 7129-7 (2019) Plastics-Film and Sheeting-Determination of Water Vapour Transmission Rate- Part 7: Calcium Corrosion Method

JIS K 7139 (2009) Plastics-Test Specimens

JIS K 7350-3 (2008) Plastics Methods of Exposure to Laboratory Light Sources Part 3 : Fluorescent UV Lamps

JIS R 3644 (1998) Glass Tubes

JIS S 2109 (2019) Gas Burning Water Heaters for Domestic Use

JIS S 2116 (2013) Water Heaters Containing Water Under Atmospheric Pressure
<table>
<thead>
<tr>
<th>Standard</th>
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<tr>
<td>JIS S 2120</td>
<td>(2019) Gas Valves</td>
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<td>JIS S 2135</td>
<td>(2013) Quick Coupling Unit for Gas Appliances</td>
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<tr>
<td>JIS S 3021</td>
<td>(2017) Oil Burning Water Boilers</td>
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<td>JIS S 3024</td>
<td>(2017) Oil Burning Water Heaters for Domestic Use</td>
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<tr>
<td>JIS S 3200-7</td>
<td>(2010) Equipment for Water Supply Service-Test Methods of Effect to Water Quality (Amendment 2)</td>
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<td>JIS S 3201</td>
<td>(2017) Testing Methods for Household Water Purifiers</td>
</tr>
<tr>
<td>JIS Z 3313</td>
<td>(2009) Flux Cored Wires for Gas Shielded and Self-Shielded Metal Arc Welding of Mild Steel, High Strength Steel and Low Temperature Service Steel</td>
</tr>
<tr>
<td>JIS Z 3621</td>
<td>(2014) Recommended Practice for Brazing</td>
</tr>
<tr>
<td>JIS Z 9102</td>
<td>(1987) Identification Marking for Piping Systems</td>
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JAPAN VALVE MANUFACTURERS ASSOCIATION


INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 14024 | Environmental Labels and Declarations-Type I Environmental Labelling-Principles and
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

[ SD-02 Shop Drawings

Plumbing System; G[, [______]]

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

] SD-03 Product Data

Water Heaters

Pumps
Backflow Prevention Assemblies

Swimming Pool [and Spa ]Suction Fittings; G[, [____]]

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies; G[, [____]].

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment
installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

[Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with JIS Z 3801. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by JIS B 8285. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they]
make as a permanent record. Structural members shall be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING. [Welding and nondestructive testing procedures are specified in Section 40 05 13.96 WELDING PROCESS PIPING.] Structural members shall be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING.

1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPOSED CURRENT)] [Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES] [and] [Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT] Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE) and Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with MLIT-M.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.
2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet JIS K 6742 for the service intended. Pipe threads (except dry seal) shall conform to JIS B 0203. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with JIS S 3200-7 and Japanese Water Supply Law, Article 20. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with or MLIT-M and JIS S 3200-7. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of JIS S 3200-7. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe.


c. Couplings for Grooved Pipe: [Ductile Iron JIS G 5502] [Malleable Iron JIS G 5705] [Copper JIS G 5502].

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with JIS B 2404. Gaskets shall be flat, 1.6 mm thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Brazing Material: Brazing material shall conform to JIS Z 3621.

f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

g. Solder Material: Solder metal shall conform to JIS Z 3284-1.

h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to JIS Z 3313.

i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.


l. Flexible Elastomeric Seals: JIS A 5758.


r. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with JIS B 2220 and shall have the manufacturer's trademark affixed in accordance with JIS B 2004 and JIS Z 9102. Flange material shall conform to JIS G 3201. Blind flange material shall conform to JIS G 3118 and JIS G 3118 cold service and JIS G 3103 and JIS G 3118 for hot service. Bolts shall be high strength or intermediate strength with material conforming to JIS G 4107 and JIS G 4303.


t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of JIS H 3401. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

u. Copper tubing shall conform to JIS H 3300, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:


b. Copper, Sheet and Strip for Building Construction: JIS H 3100.

c. Asphalt Roof Cement: JIS A 6005.

d. Hose Clamps: MLIT-M.

e. Metallic Cleanouts: JCW 203.

f. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be
nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.


h. Hypochlorites: JWWA K 120.

i. Liquid Chlorine: JWWA K 120.


k. Thermometers: JIS B 7414. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MLIT-M.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

<table>
<thead>
<tr>
<th>Description</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butterfly Valves</td>
<td>JPF-DP-001</td>
</tr>
<tr>
<td>Cast-Iron Gate Valves, Flanged and Threaded Ends</td>
<td>JIS B 2031</td>
</tr>
<tr>
<td>Cast-Iron Swing Check Valves, Flanged and Threaded Ends</td>
<td>JIS B 2011</td>
</tr>
<tr>
<td>Ball Valves with Flanged Butt-Welding Ends for General Service</td>
<td>JV-5</td>
</tr>
<tr>
<td>Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends</td>
<td>JV-5</td>
</tr>
<tr>
<td>Bronze Gate, Globe, Angle, and Check Valves</td>
<td>JV-5</td>
</tr>
</tbody>
</table>
2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 20 mm male inlet threads, hexagon shoulder, and 20 mm hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Lawn Faucets

Lawn faucets shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 20 mm pipe. Body shall be suitable for wrench grip. Faucet spout shall have 20 mm exposed hose threads. Faucet handle shall be securely attached to stem.
2.3.4 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.3.5 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to JIS B 8225. Relief valves for systems where the maximum rate of heat input is less than 59 kW shall have 20 mm minimum inlets, and 20 mm outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW shall have 25 mm minimum inlets, and 25 mm outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.6 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C of any setting.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 6.1 LPF to accommodate existing plumbing capacity. [ JIS B 2308 302 stainless steel] [Vitreous China], nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear [white][____], acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains [may contain acetal resin, fluorocarbon, nylon,
acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years][shall be copper alloy with all visible surfaces chrome plated]. [Plastic in contact with hot water shall be suitable for 82 degrees C water temperature.]

2.4.1 Lavatories

[Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled.][Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.] Provide faucet with a maximum flow rate of 1.9 L/min at a flowing pressure of 414 kPa. Water volume must be limited to 1.0 L per metering cycle.

2.4.2 Automatic Controls

Provide automatic, sensor operated faucets and flush valves to comply with JIS A 5207 and lavatory faucets, urinals, and water closets. Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.4.3 Flush Valve Water Closets

JIS A 5207, [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 Stainless Steel], siphon jet, elongated bowl, [floor-mounted, floor outlet][wall mounted, wall outlet]. Top of toilet seat height above floor shall be 360 to 380 mm, except 435 to 480 mm for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide [white] [_____] solid plastic elongated [open-front seat] [closed-front seat with cover].

Water flushing volume of the water closet and flush valve combination shall not exceed 4.85 liters per flush.[Provide a dual-flush water closet and flush valve combination that will also provide a second flushing water volume not to exceed 4.8 liters per flush.]

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 280 mm above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls.[Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.][Provide piston type, oil operated, flush valve and wall support for salt water service.]

2.4.4 Flush Valve Urinals

JIS A 5207, [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 430 mm above the floor. Provide urinal with the rim 610 mm above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.9 liters per flush. Provide large diameter flush valve including angle
control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 280 mm above the fixture. [Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.] [Provide piston type, oil operated, flush valve and wall support for salt water service.]

### 2.4.5 Wheelchair Flush Valve Type Urinals

JIS A 5207 [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, 510 mm long from wall to front of flare, and JIS B 2061 trim. Provide large diaphragm (not less than 65 mm upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to JIS B 2061, including vacuum breaker and angle (control-stop) valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 1.9 liters per flush. Furnish urinal manufacturer's certification of conformance. Mount urinal with front rim a maximum of 430 mm above floor and flush valve handle a maximum of 1120 mm above floor for use by handicapped on wheelchair. [Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.]

### 2.4.6 Flush Tank Water Closets

JIS A 5207 [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], siphon jet, round bowl, pressure assisted, floor-mounted, floor outlet. Top of toilet seat height above floor shall be 360 to 380 mm, except 435 to 480 mm for wheelchair water closets. [Nonfloat swing type flush tank valves are not acceptable.] [Gravity tank type water closets are not permitted.] Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet shall not exceed 4.8 liters per flush. [Provide a dual-flush toilet with a second flushing option that shall not exceed 4.1 liters per flush.] Provide [white] [_____] solid plastic round closed-front seat with cover. [Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.]

### 2.4.7 Non-Flushing Toilets

[Provide composting toilets in accordance with manufacturer's recommendations.][Provide vacuum toilet systems in accordance with manufacturer's recommendations.]

### 2.4.8 Wall Hung Lavatories

JIS A 5207 [white] [_____] vitreous china, JIS B 2308 and JIS B 2309 302 stainless steel], straight back type, minimum dimensions of 480 mm, wide by 430 mm front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. [Provide aerator with faucet.] Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 865 mm above floor and with 740 mm minimum clearance from bottom of the front rim to floor. [Provide top-mounted washerless centerset lavatory faucets.][Provide top-mounted solenoid-activated lavatory
faucets including electrical-operated light-beam-sensor to energize the solenoid.]
[Provide filters for chlorine in supply piping to faucets.]

2.4.9 Countertop Lavatories

JIS A 5207 [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], self-rimming, minimum dimensions of 480 mm wide by 430 mm front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer.[Provide aerator with faucet.]
[Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Mount counter with the top surface 865 mm above floor and with 737 mm minimum clearance from bottom of the counter face to floor.]
[Provide top mounted washerless centerset lavatory faucets.]
[Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.]
[Provide filters for chlorine in supply piping to faucets.]

2.4.10 Kitchen Sinks

JIS B 2308 and JIS B 2309 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 840 mm wide by 535 mm front to rear, two compartments, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 90 mm drain outlet.[Provide aerator with faucet.]
[Water flow rate shall not exceed 8.3 L per minute when measured at a flowing water pressure of 414 kPa.]
[Provide stainless steel drain outlets and stainless steel cup strainers.]
[Provide separate 38 mm P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray.]
[Provide filters for chlorine in supply piping to faucets.]
[Provide JIS A 4420 waste disposer in right compartment.]
[Provide pedal valve for foot-operated flow control.]
[Provide secondary kitchen sink that drains to graywater system.]
[Provide sink with disposal chute to compost bucket under sink.]

2.4.11 Service Sinks

JIS A 5207, [white] [_____] vitreous china JIS B 2308 and JIS B 2309 302 stainless steel] with integral back and wall hanger supports, minimum dimensions of 560 mm wide by 510 mm front to rear, with two supply openings in 254 mm high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 19 mm external hose threads.

2.4.12 Drinking-Water Coolers

JIS C 9618 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 5 ml per second minimum capacity, stainless steel splash receptor and basin, [bottle filler] and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 915 mm above floor and at front of unit basin. Spouts shall direct water flow at least 100 mm above unit basin and trajectory parallel or nearly parallel to the front of unit. [Provide filters for chlorine in supply piping to faucets.]
Provide concealed steel pipe chair carriers.
2.4.13 Wheelchair Drinking Water cooler

JIS C 9618 wall-mounted bubbler style with concealed chair carrier, air-cooled condensing unit, 5 mL per second minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 690 mm minimum knee clearance from front bottom of unit to floor and 915 mm maximum spout height above floor [and bottle filler]. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. [Provide filters for chlorine in supply piping to faucets.]

2.4.14 Plastic Bathtub/Shower Units

JIS A 5207 four piece [white] [_____] solid acrylic pressure molded fiberglass reinforced plastic bathtub/shower units. Units shall be scratch resistant, waterproof, and reinforced. Provide showerheads meeting the requirements of the paragraph BATHTUB AND SHOWER FAUCETS AND DRAIN FITTINGs.[ Provide flow restrictor in handshower to flow 6.6 L/min. ] [Provide filters for chlorine in supply piping to faucets and showerheads.]

Provide recessed type units approximately 1520 mm wide, 760 mm front to rear, 1830 mm high with 380 mm high rim for through-the-floor drain installation with unit bottom or feet firmly supported by a smooth level floor. Provide left or right drain outlet units as required. Units shall have built-in soap dish and minimum of 305 mm long stainless steel horizontal grab bar located on back wall for standing use. Units shall meet performance requirements of JIS A 5207. Install unit in accordance with the manufacturer's written instructions. Finish installation by covering unit attachment flanges with wall board in accordance with unit manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the unit and the adjacent walls and floor surfaces.

2.4.15 Plastic Bathtubs

JIS A 5207 one piece [white] [_____] solid acrylic pressure molded fiberglass reinforced plastic bathtubs. Bathtubs shall be scratch resistant, waterproof, and reinforced. Provide recessed type bathtubs approximately 1520 mm wide, 760 mm front to rear, 380 mm high rim for through-the-floor drain installation with bathtub bottom or feet firmly supported by a smooth level floor. Provide left or right drain outlet bathtub as required. [Provide filters for chlorine in supply piping to faucets.]

Bathtubs shall meet performance requirements of JIS A 5207. Install bathtub in accordance with the manufacturer's written instructions. Finish installation by covering bathtub attachment flanges with dry-wall in accordance with bathtub manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the bathtub and the adjacent walls and floor surfaces.

2.4.16 Plastic Shower Stalls

JIS A 5207 four piece [white] [_____] solid acrylic pressure molded fiberglass reinforced plastic shower stalls. Shower stalls shall be scratch resistant, waterproof, and reinforced. Provide showerheads meeting the requirements of the paragraph BATHTUB AND SHOWER FAUCETS AND DRAIN FITTINGs.[ Provide flow restrictor in handshower to flow 6.6 L/min. ] [Provide filters for chlorine in supply piping to showerheads.]

Provide recessed type shower stalls approximately 915 mm wide, 915 mm front to rear, 1830 mm high, and 125 high mm high curb with shower stall bottom or feet firmly supported by a smooth level floor. Provide PVC shower floor drains
and stainless steel strainers. Shower stalls shall meet performance requirements of JIS A 5207. Install shower stall in accordance with the manufacturer's written instructions. Finish installation by covering shower stall attachment flanges with dry-wall in accordance with shower stall manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the top, sides, and bottom of shower stalls and bathroom walls and floors.

2.4.17 Plastic Bathtub Liners

JIS A 5532 one piece [white] [_____] plastic bathtub liners. Existing bathtubs shall be identified and measured to insure proper identification in order that each new bathtub liner shall be custom molded to fit the exact contours of the existing bathtubs. Provide left or right drain outlet bathtub liners as required. Bathtub liners shall be inserted over and into the existing bathtubs without disturbing the existing ceramic tile wainscot walls and existing floor material. Prepare the existing cast-iron bathtubs, ceramic tile wainscots, and floor to receive the new bathtub liners in accordance with the bathtub liner manufacturer's written instructions. Installation personnel shall be trained by the bathtub liner manufacturer. Seal the bathtub liner to existing bathtub with waterproof adhesive as required to keep moisture out from behind the bathtub liner. Provide smooth [white] [_____] waterproof bathtub sealant between bathtub drains, bathtub, and bathtub liners. Provide replacement chromium-plated overflow cover plates and push-pull bathtub drain stopper assembly. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the bathtub liner and the adjacent walls and floor surfaces in accordance with the bathtub liners manufacturer's written instructions.

2.4.18 Plastic Bathtub Wall Surrounds

JIS A 5207 three piece [white] [_____] sectional pressure molded fiberglass plastic bathtub wall surrounds suitable for installation with existing bathtubs which are approximately 1520 mm wide by 760 mm front to rear. Wall surrounds shall have built-in soap dish and minimum of 305 mm long stainless steel horizontal grab bar located on back wall for standing use. Bathtub wall surrounds shall meet performance requirements of JIS A 5207 for compliance. Install bathtub wall surrounds in accordance with the manufacturers written instructions. Finish installation by covering bathtub wall surround attachment flanges with dry-wall in accordance with bathtub wall surround manufacturer's recommendations. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the bathtubs and the adjacent walls and floor surfaces.

2.4.19 Precast Terrazzo Shower Floors

Terrazzo shall be made of marble chips cast in white portland cement to produce 25 mPa minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.20 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 25 mPa minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.
2.4.21 Bathtubs, Cast Iron

JIS A 5207 [white] [_____] enameled cast iron, recessed type, minimum dimensions of 1520 mm wide by 760 mm front to rear by 410 mm high with drain outlet for above-the-floor drain installation. Provide left or right drain outlet bathtub as indicated. [Provide filters for chlorine in supply piping to faucets.]

2.4.22 Bathtubs, Porcelain

JIS A 5207 [white] [_____] porcelain bonded to enameling grade metal, bonded to a structural composite, recessed type, minimum dimensions of 1520 mm wide by 760 mm front to rear by 410 mm high with drain outlet for above-the-floor drain installation. Provide left or right drain outlet bathtub as indicated. [Provide filters for chlorine in supply piping to faucets.]

2.4.23 Emergency Eyewash and Shower

Ministry of Labour Ordinance (Tokutei-Kagaku-bushitsu-Shogai-Yobou-Kisoku) Article 38, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.4.24 Emergency Eye and Face Wash

Ministry of Labour Ordinance (Tokutei-Kagaku-bushitsu-Shogai-Yobou-Kisoku) Article 38, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 0.19 L/s of aerated water at 207 kPa (gage) flow pressure, with eye and face wash nozzles 840 to 1140 mm above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum. [Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 15.5 to 35 degrees C.][Provide packaged, UL listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within enclosures[ and for explosion proof service within enclosures].]

2.5 BACKFLOW PREVENTERS

Backflow preventers with intermediate atmospheric vent shall conform to JIS S 3200-5. Reduced pressure principle backflow preventers shall be approved product of quality certification center of JWWA. Hose connection vacuum breakers shall be approved product of quality certification center of JWWA. Pipe applied atmospheric type vacuum breakers shall be approved product of quality certification center of JWWA. Pressure vacuum breaker assembly shall be approved product of quality certification center of JWWA. Air gaps in plumbing systems shall conform to Ministry of Health Labor and Welfare Ordinance Article 123.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral
seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to JCM 201.

2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to JIS K 7350-3. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer, unless otherwise indicated.

2.6.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Bathtub and Shower Faucets and Drain Fittings

Provide single control pressure equalizing bathtub and shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide tubing mounted from behind the wall between bathtub faucets and shower heads and bathtub diverter spouts. Provide separate globe valves or angle valves with union connections in each supply to faucet. Provide trip-lever pop-up drain fittings for above-the-floor drain installations. The top of drain pop-ups, drain outlets, tub overflow outlet, and; control handle for pop-up drain shall be chromium-plated or polished stainless steel. Linkage between drain pop-up and pop-up control handle at bathtub overflow outlet shall be copper alloy or stainless steel. Provide 40 mm copper alloy adjustable tubing with slip nuts and gaskets between bathtub overflow and drain outlet; chromium-plated finish is not required.[ Provide bathtub and shower valve with ball type control handle.]

2.6.3 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 300 mm nominal overall width or diameter and 250 mm nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to JIS A 5207.

2.6.4 Floor Sinks

Floor sinks shall be [circular] [square], with 300 mm nominal overall width
or diameter and 250 mm nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, [aluminum][ABS] sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.5 Boiler Room Drains

Boiler room drains shall have combined drain and trap, hinged grate, removable bucket, and threaded brass cleanout with brass backwater valve. The removable galvanized cast-iron sediment bucket shall have rounded corners to eliminate fouling and shall be equipped with hand grips. Drain shall have a minimum water seal of 100 mm. The grate area shall be not less than 0.065 square meters.

2.6.6 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.6.7 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar: 0.023 square meters

Height of funnel: 95 mm

Diameter of lower portion: 50 mm of funnel

Diameter of upper portion: 100 mm of funnel

2.6.8 Roof Drains and Expansion Joints

Roof drains shall conform to MLIT-M, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be
complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 3.5 mm. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.6.9 Swimming Pool [and Spa] Suction Fittings

Pool water suction fittings in swimming pools [and spas] shall comply with Pool Safety Standard Guidelines. The compliance of the fitting shall include of the associated drain cover, sump, and hardware.

2.7 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

2.7.1 Sheet Copper

Sheet copper shall be 4.9 kg per square meter weight.

2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 1.015 mm minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with JIS K 5981.

2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 1.015 mm minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. JIS K 7139

Ultimate Tensile Strength: 1.79 MPa
Ultimate Elongation: 398 percent
100 Percent Modulus: 3.07 MPa

b. JIS K 7128-3

Tear Strength: 53 kilonewtons per meter

c. JIS Z 0208 and JIS K 7129-7:

Permeance: 0.46 ng per Pa per second per sq meter

d. Other Properties:

Specific Gravity: 1.29
PVC Solvent: Weldable
Cold Crack: minus 47 degrees C
Dimensional stability 100 degrees C
Hardness, Shore A: 89

2.8 TRAPS

Unless otherwise specified, traps shall be [plastic per JIS K 6741 and JIS K 7014] [or] [copper-alloy adjustable tube type with slip joint inlet and swivel]. Traps shall be without a cleanout. [Provide traps with removable access panels for easy clean-out at sinks and lavatories.] Tubes shall be copper alloy with walls not less than 0.813 mm thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm. The interior diameter shall be not more than 3.2 mm over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.9 INTERCEPTORS

2.9.1 Grease Interceptor

Grease interceptor of the size indicated shall be of reinforced concrete, [or precast concrete construction] [or equivalent capacity commercially available steel grease interceptor] with removable three-section, 9.5 mm checker-plate cover, and shall be installed outside the building. Steel grease interceptor shall be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer. Concrete shall have 21 MPa minimum compressive strength at 28 days. Provide flow control fitting.

2.9.2 Oil Interceptor

Cast iron or welded steel, coated inside and outside with white acid resistant epoxy, with internal air relief bypass, bronze cleanout plug, double wall trap seal, removable combination pressure equalizing and flow diffusing baffle and sediment bucket, horizontal baffle, adjustable oil draw-off and vent connections on either side, gas and watertight gasketed nonskid cover, and flow control fitting.

2.9.3 Sand Interceptors

Sand interceptor of the size indicated shall be of reinforced concrete, [or precast concrete construction] [or equivalent capacity commercially available steel sand interceptor] with manufacturer's standard checker-plate cover, and shall be installed [outside the building][top flush with the floor][floor mounted]. Steel sand interceptor shall be installed in accordance with manufacturer's recommendations and shall be coated to resist corrosion as recommended by the manufacturer.[Concrete shall have 21 MPa minimum compressive strength at 28 days.]
2.10 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 49 to 82 degrees C. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III in PART 3 of this Section for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 liters storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 93 degrees C water temperature and 1034 kPa working pressure. The expansion tank size and acceptance volume shall be [_____] [as indicated].

2.10.1 Automatic Storage Type

Heaters shall be complete with [control system,] [control system, temperature gauge, and pressure gauge,] and shall have combination pressure and temperature relief valve.

2.10.1.1 Oil-Fired Type

Oil-fired type water heaters shall conform to JIS S 3024.

2.10.1.2 Gas-Fired Type

Gas-fired water heaters shall conform to JIS S 2109 when input is 70 KW per hour or less for simultaneous heater and 42 KW per hour or less for storage type or JIS S 2116 for heaters with input greater than 42 KW per hour.

2.10.1.3 Electric Type

Electric type water heaters shall conform to JIS C 9219-1 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time.

2.10.1.4 Indirect Heater Type

Steam and high temperature hot water (HTHW) heaters with storage system shall be the assembled product of one manufacturer, and shall be in accordance with MLIT-M. The storage tank shall be as specified in paragraph HOT-WATER STORAGE TANKS. The heat exchanger shall be [double wall] [single wall] type that separates the potable water from the heat transfer medium with a space vented to the atmosphere.

a. HTHW Energy Source: The heater element shall have a working pressure of 2758 kPa with water at a temperature of 204 degrees C. The heating surface shall be based on 0.093 square meter of heating surface to heat 76 L or more of water in 1 hour from 4 to 82 degrees C using hot water at a temperature of 178 degrees C. Carbon steel heads shall be used.
Tubing shall conform to JIS H 3300. Heating elements shall withstand an internal hydrostatic pressure of 4137 kPa for not less than 15 seconds without leaking or any evidence of damage.

b. Steam Energy Source: The heater element shall have a working pressure of 1034 kPa per square meter gauge (psig) with steam at a temperature of 185 degrees C. The heating surface shall be based on 0.093 square meter of heating surface to heat 76 L or more of water in 1 hour from 4 to 82 degrees C using steam at atmospheric pressure. [Cast iron] [bronze] heads shall be used. Tubing shall be light-drawn copper tubing conforming to JIS H 3300. Heating elements shall withstand an internal hydrostatic pressure of 1551 kPa for not less than 15 seconds without leaking or any evidence of damage.

2.10.2 Instantaneous Water Heater

Heater shall be crossflow design with service water in the coil and [steam] [hot water] in the shell. An integral internal controller shall be provided, anticipating a change in demand so that the final temperature can be maintained under all normal load conditions when used in conjunction with [pneumatic control system] [pilot-operated temperature control system]. Normal load conditions shall be as specified by the manufacturer for the heater. Unit shall be manufactured in accordance with MLIT-M, and shall be certified for 1.03 MPa working pressure in the shell and 1.03 MPa working pressure in the coils. Shell shall be carbon steel with copper lining. Heads shall be [cast iron] [bronze] [carbon steel plate with copper lining]. Coils shall be [copper] [copper-nickel]. Shell shall have metal sheathed fiberglass insulation, combination pressure and temperature relief valve, and thermometer. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.10.3 Electric Instantaneous Water Heaters (Tankless)

JIS C 9335-2-35 flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.10.4 Phenolic Resin Coatings for Heater Tubes

The phenolic resin coating system shall be applied at either the coil or coating manufacturer's factory in accordance with manufacturer's standard proven production process. The coating system shall be a product specifically intended for use on the material the water heating tubes/coils are made of and shall be acceptable for use in potable water systems.

[The entire exterior surface] [and] [the first 125 mm to 200 mm inside the tubes] of each coil shall be coated with phenolic resin coating system.

2.10.4.1 Standard Product

Provide a phenolic resin coating system that is a standard product of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship.

Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

Prior to this two year period, these standard products were sold on the commercial market using advertisements in manufacturers' catalogs or
brochures. These manufacturers' catalogs, or brochures shall have been copyrighted documents or be identified with a manufacturer's document number.

2.11 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, and nameplate shall indicate the working pressure. The tank shall be steel type in accordance with MLIT-M. Each tank shall be equipped with a thermometer, conforming to JIS B 7414, style and form as required for the installation, and with 175 mm scale. Thermometer shall have a separable socket suitable for a 20 mm tapped opening. Tanks shall be equipped with a pressure gauge 155 mm minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.12 PUMPS

2.12.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated. The across-the-line magnetic controller shall be equipped with industrial use type enclosure. Integral size motors shall be the premium efficiency type in accordance with JIS C 4212. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 75 and 150 mm above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in an industrial use type enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.12.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be [integrated mounted on a cast-iron or steel subbase,] [close-coupled with an overhung impeller,] [or] [supported by the piping on which it is installed]. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in an industrial type enclosure with "START-STOP" switch in cover.

Integral size motors shall be premium efficiency type in accordance with JIS C 4212. Pump motors smaller than 746 W shall have integral thermal
overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.12.3 Booster Pumps

2.12.3.1 Centrifugal Pumps

Horizontal split-case centrifugal-type booster pumps shall be furnished. The capacities shall be as shown, and the speed shall not exceed 1800 rpm. Pumps shall have a casing of close-grained iron or steel with smooth water passages. A gasket shall be provided between the upper and lower halves of the casing. Suction and discharge connections shall be flanged. Impellers shall be nonoverloading, bronze, balanced to eliminate vibration, and shall be keyed to corrosion-resisting steel shafts. The casings shall be fitted with bronze wearing or sealing rings. Bearings shall be cartridge type, enabling the entire rotating element to be removed without disturbing alignment or exposing the bearings to dirt, water, and other foreign matter. Pumps shall be provided with mechanical seals. Seal boxes shall be machined in the pump casing and at both sides of the pump, and shall be of sufficient depth to include a conventional bronze seal ring and rows of shaft packing. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity in liters per second, head in meters, efficiency, brake wattage, and operation in parallel with similar pumps. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. The electric motor shall be sized for non-overload when operating at any point along the characteristic curve of the pump. Guards shall shield exposed belts and moving parts.

2.12.3.2 Controls

Each pump motor shall be provided with enclosed across-the-line-type magnetic controller complete in an industrial use type enclosure with three position, "HAND-OFF-AUTOMATIC," selector switch in cover. Pumps shall be automatically started and stopped by float or pressure switches, as indicated. The pumps shall start and stop at the levels and pressures indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously keeping a third pump as a standby.

2.12.4 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.12.5 Sewage Pumps

Provide single type duplex type with automatic controls to alternate the operation from one pump to the other pump and to start the second pump in the event the first pump cannot handle the incoming flow. Provide high water alarm and check valve.
2.13 WATER PRESSURE BOOSTER SYSTEM

2.13.1 Constant Speed Pumping System

Constant speed pumping system with pressure-regulating valves shall employ one lead pump for low flows, and one or more lag pumps for higher flows. Pressure-regulating valves shall be provided with nonslam check feature. The factory prepiped and prewired assembly shall be mounted on a steel frame, complete with pumps, motors, and automatic controls. The system capacity and capacity of individual pumps shall be as indicated. Current sensing relays shall provide staging of the pumps. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the suction and discharge headers. The control panel shall be industrial use type enclosure. The control panel shall include the following: No-flow shutdown; 7-day time clock; audiovisual alarm; external resets; manual alternation; magnetic motor controllers; time delays; transformer; current relays; "HAND-OFF-AUTOMATIC" switches for each pump; minimum run timers; low suction pressure cutout; and indicating lights for power on, individual motor overload, and low suction pressure. The control circuit shall be interlocked so that the failure of any controller shall energize the succeeding controller.

2.13.2 Hydro-Pneumatic Water Pressure System

Hydro-pneumatic water tank shall be constructed in accordance with pressure vessel construction standard (atsuryoku-youki-kouzou-kisoku).

2.13.3 Variable Speed Pumping System

Variable speed pumping system shall provide system pressure by varying speed and number of operating pumps. The factory prepiped and prewired assembly shall be mounted on a steel frame complete with pumps, variable speed drives, motors, and controls. The variable speed drives shall be the oil-filled type capable of power transmission throughout their complete speed range without vibration, noise, or shock loading. Each variable speed drive shall be run-tested by the manufacturer for rated performance, and the manufacturer shall furnish written performance certification. System shall have suppressors to prevent noise transmission over electric feed lines. Required electrical control circuitry and system function sensors shall be supplied by the variable speed drive manufacturer. The primary power controls and magnetic motor controllers shall be installed in [the controls supplied by the drive manufacturer] [the motor control center]. The sensors shall be located in the system to control drive speed as a function of [constant pump discharge pressure] [constant system pressure at location indicated]. Connection between the sensors and the variable speed drive controls shall be accomplished with [hydraulic sensing lines] [copper wiring] [telemetry]. Controls shall be in industrial use type enclosures.

2.14 COMPRESSED AIR SYSTEM

2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including [_____] phase, [_____] volt motor controls, switches, wiring, accessories, and motor controllers, in an industrial use type enclosure. Air compressors shall have manufacturer's name and address, together with trade name, and catalog number on a nameplate securely attached to the equipment. Each
compressor shall [start and stop automatically at upper and lower pressure limits of the system] [regulate pressure by constant speed compressor loading and unloading] [have a manual-off-automatic switch that when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay shall allow the compressor to operate for an adjustable length of time unloaded, then stop the unit].

Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with [automatic] [manual] alternation system. Each compressor motor shall be provided with an across-the-line-type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receiver to remove moisture and oil condensate before the air enters the receiver.

Aftercoolers shall be either air- or water-cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.14.2 Lubricated Compressors

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 1.03 MPa and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

2.14.3 Air Receivers

Receivers shall be designed for 1.38 MPa working pressure. Receivers shall be factory air tested to 1-1/2 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with Construction code for pressure vessel (CCPV) and shall have the design working pressures specified herein.

2.14.4 Intake Air Supply Filter

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 microns. Filter body and media shall withstand a maximum 862 kPa, capacity as indicated.

2.14.5 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 862 kPa and a maximum temperature of 93 degrees C. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, and threaded.
connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 kPa to 862 kPa. Regulator shall be sized as indicated.

2.15 DOMESTIC WATER SERVICE METER

The requirements for metering and submetering are specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

[Cold water meters 50 mm and smaller shall be positive displacement type conforming to JIS B 8570-1. Cold water meters 64 mm and larger shall be turbine type conforming to JIS B 8570-1. Meter register may be round or straight reading type, [indicating [_____] ] [as provided by the local utility]. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

2.16 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide [high efficiency type, ] single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with JIS C 4212.[ In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212.] Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.
2.17 MISCELLANEOUS PIPING ITEMS

2.17.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.17.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where [supply] drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.17.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.17.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.17.3 Pipe Hangers (Supports)

Provide pipe hangers and supports in accordance with MLIT-M.

2.17.4 Nameplates

Provide 3.2 mm thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 6.4 mm high normal block lettering into the white core. Minimum size of nameplates shall be 25 by 63 mm. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.17.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

a. Identification of the sensor and its operation with [graphic] [written] [Braille] description.

b. Range of the sensor.

c. Battery replacement schedule.
3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m outside the building, unless otherwise indicated. A [gate valve] [full port ball valve] [ball valve] and drain shall be installed on the water service line inside the building approximately 150 mm above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm below the [average local frost depth] [finish grade] or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with
the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 20 mm hose bibb with renewable seat and [gate] [full port ball] [ball] valve ahead of hose bibb. At other low points, 20 mm brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 100 mm in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or
3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with products conforming to the Performance Standards Compliant Product (PSCP) of the Water Supply Law. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to JIS S 3200-3. Vertical capped pipe columns will not be permitted.

3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 862 kPa working pressure. Compressed air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to JIS B 0203. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in
accordance with the tool manufacturer's recommendations.

The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.1.3.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm and smaller; flanges shall be used on pipe sizes 80 mm and larger.

3.1.3.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.6 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with JIS Z 3621, JIS H 3300, and JIS H 3300 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm and smaller. Soldered joints shall conform to JIS H 3300 and JIS H 3300. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with MLIT-M.

d. Press connection. Copper press connections shall be made in strict accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer of that joint. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.
3.1.3.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.8 Glass Pipe

Joints for corrosive waste glass pipe and fittings shall be made with corrosion-resisting steel compression-type couplings with acrylonitrile rubber gaskets lined with polytetrafluoroethylene.

3.1.3.9 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

3.1.3.10 Other Joint Methods

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPLIED CURRENT)][Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES] [and] [Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT][Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)][Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT] and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to JWWA K 115 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.
3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulk and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of [6 mm] [25 mm] clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in non-bearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic.

Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to JIS A 5758 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 12 mm from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and [concrete] [masonry] wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.
3.1.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulkng and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

a. A standard roof coupling for threaded pipe up to 150 mm in diameter.

b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 6 to 13 mm wide by 6 to 10 mm deep shall be formed.
around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.6.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section 13 48 00 [SEISMIC] BRACING FOR MISCELLANEOUS EQUIPMENT and [Section 23 05 48.19 [SEISMIC] BRACING FOR HVAC] [Section 22 05 48.00 20 MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL] [as shown]. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in [Section 05 12 00 STRUCTURAL STEEL] [Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS] [Section 05 51 33 METAL LADDERS] [Section 05 52 00 METAL RAILINGS] [Section 05 51 00 METAL STAIRS].

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MLIT-M except as modified herein.

a. Horizontal pipe supports shall be spaced as specified in MLIT-M and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C for PVC and 82 degrees C for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

b. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m nor more than 2 m
from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

3.1.8.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to JIS B 8285. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be [cast iron] [or] [plastic].
3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 150 mm above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to JIS S 2120, and JIS S 2135, for gas fired and JIS S 3024, JIS S 3021 and JIS S 3030 for oil fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 600 mm just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 600 mm before turning in an upward direction.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.2.6 Direct Fired and Domestic Water Heaters

Notify the Contracting Officer when any direct fired domestic water heater over 117 kw is operational and ready to be inspected and certified.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chrome-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and
installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 1 m above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 760 mm above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the [wall] [flushometer stop] [flushometer spud].

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm above floor. Wall-hung service sinks shall be mounted with rim 700 mm above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.
3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 6 mm thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with MLIT-M at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced,
maintained, or replaced. Access panels shall be as specified in [Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS] [Section 05 51 33 METAL LADDERS] [Section 05 52 00 METAL RAILINGS] [Section 05 51 00 METAL STAIRS].

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to JIS A 4421. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 150 mm for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.3.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flintlock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than 1 liter per square meter. A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

3.3.10.3 Plasticized Chlorinated Polyethylene Shower Pans

Corners of plasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 12 mm from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane.
Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 12 mm from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 4 degrees C the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 0.73 kg per square meter dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 150 mm in room areas and 75 mm above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 25 mm of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 50 mm. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 600 or 900 mm at a time shall be welded. On wood subflooring, two layers of 0.73 kg per square meter felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation
unit installation shall limit vibration to [_____] percent of the lowest equipment rpm.

3.4.1 Tank- or Skid-Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer. Compressors shall be mounted to resist seismic loads as specified in Section 23 05 48.19 [SEISMIC] BRACING FOR HVAC.

3.4.2 Foundation-Mounted Compressors

[Foundation attachment shall be as recommended by the compressor manufacturer, except the foundation shall weigh not less than three times the weight of the moving parts.] Compressors shall be mounted to resist seismic loads as specified in Section 23 05 48.19 [SEISMIC] BRACING FOR HVAC.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 12 mm in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 m width, 750 mm height, and 12 mm thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm transparent plastic cover. Unless otherwise directed, the color code
symbols shall be approximately 20 mm in diameter and the related lettering in 12 mm high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

<table>
<thead>
<tr>
<th>Color</th>
<th>System</th>
<th>Item</th>
<th>Location</th>
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<td></td>
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</table>

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.8.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with JIS Z 2371 and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 3 mm on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 50 degrees C shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after
the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 50 Degrees C: Immediately after cleaning, the metal surfaces subject to temperatures less than 50 degrees C shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat.

b. Temperatures Between 50 and 205 Degrees C: Metal surfaces subject to temperatures between 50 and 205 degrees C shall receive two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm.

c. Temperatures Greater Than 205 Degrees C: Metal surfaces subject to temperatures greater than 205 degrees C shall receive two coats of 315 degrees C heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with MLIT-M, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure and reasons for choosing this option in lieu of the smoke test to the Contracting Officer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.


3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, gauges shall be tested annually for accuracy in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. Report form for each assembly shall include, as a minimum, the following:
If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 25 mm for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 1.03 MPa and hold this pressure for 2 hours with no drop in pressure.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with [hot] potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 1.2 meters per second through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge.
water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by JIS S 3200-7, Section 9, shall be flushed a minimum of 1 L per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by JIS S 3201. The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.
3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with Japanese Water Supply Law, Article 20 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable water until the residual chlorine level is reduced to less than one part per million. During the flushing period, each valve and faucet shall be opened and closed several times.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer. Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with MLIT-M. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.10 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams.
The framed instructions shall be posted before acceptance testing of the systems.

3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 21 degrees C delta T.

SL = Standby loss is maximum (Btu/h) based on a 38.9 degree C temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.11.1 Storage Water Heaters

3.11.1.1 Electric

a. Storage capacity of 227 liters shall have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.

b. Storage capacity of 227 liters or more shall have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

3.11.1.2 Gas

a. Storage capacity of 189 liters or less shall have a minimum energy factor (EF) of 0.67 or higher per FEMP requirements.

b. Storage capacity of 75.7 liters or more and input rating of 23 KW or less:

c. Rating of less than 22980 W: (75,000 Btu/h) ET shall be 80 percent; maximum SL shall be (Q/800+110x(V^(1/2))), per JIS S 2109

3.11.1.3 Oil

a. Storage capacity of 75.7 liters or more and input rating of 31 KW or less:

b. Rating of less than 309.75 W/L or input rating more than 31 KW: ET shall be 78 percent; maximum SL shall be (Q/800+100x(V^(1/2))), per JIS S 2109.

3.11.2 Unfired Hot Water Storage

All volumes and inputs: shall meet or exceed R-12.5.

3.11.3 Instantaneous Water Heater

3.11.3.1 Gas

a. Rating of 309.75 W/L and greater and less than 7.57 L with an input greater than 14.66 kW and less than 58.62 kW
b. Rating of 309.75 W/L and greater and less than 37.85 L with an input of 58.62 kW and greater shall have a minimum thermal efficiency (ET) of 80 percent per JIS S 2109

c. Rating of 309.75 W/L and greater and 37.85 L and greater with an input of 58.62 kW and greater shall have a minimum thermal efficiency (ET) of 80 percent and the maximum SL shall be \( \frac{Q}{800} + 110 \times (V^{\frac{1}{2}}) \) per JIS S 2109

3.11.3.2 Oil

a. Rating of 309.75 W/L and greater and less than 7.57 L with an input of 61.55 kW and less

b. Rating of 309.75 W/L and greater and less than 37.85 L with an input greater than 61.55 kW shall have a minimum thermal efficiency (ET) of 80 percent per JIS S 2109

c. Rating of 309.75 W/L and 37.85 L and greater with an input of greater than 61.55 kW shall have a minimum thermal efficiency (ET) of 78 percent and the maximum SL shall be \( \frac{Q}{800} + 110 \times (V^{\frac{1}{2}}) \) per JIS S 2109

3.11.4 Pool Heaters

a. Gas/oil fuel, capacities and inputs: ET shall be 78 percent.

b. Heat Pump, All capacities and inputs shall meet a COP of 4.0.

3.12 TABLES

<table>
<thead>
<tr>
<th>Pipe and Fitting Materials</th>
<th>SERVICE A</th>
<th>SERVICE B</th>
<th>SERVICE C</th>
<th>SERVICE D</th>
<th>SERVICE E</th>
<th>SERVICE F</th>
<th>SERVICE G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast iron soil pipe and fittings, hub and spigot, JIS G 5526 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.</td>
<td>X</td>
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</table>

TABLE I

PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS
<table>
<thead>
<tr>
<th>Item</th>
<th>Pipe and Fitting Materials</th>
<th>SERVICE A</th>
<th>SERVICE B</th>
<th>SERVICE C</th>
<th>SERVICE D</th>
<th>SERVICE E</th>
<th>SERVICE F</th>
<th>SERVICE G</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Cast iron soil pipe and fittings, hubless, JIS G 5526 and JIS B 2302 and JIS B 2301. Pipe and fittings shall be marked with the CISPI trademark.</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>3</td>
<td>Cast iron drainage fittings, threaded, JIS B 2302 and JIS B 2301 for use with Item 10</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>4</td>
<td>Cast iron screwed fittings (threaded), JIS B 2302 and JIS B 2301 for use with Item 10</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>5</td>
<td>Grooved pipe couplings, ferrous and non-ferrous pipe JIS G 5502 and JIS G 5705</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>6</td>
<td>Ductile iron grooved joint fittings for ferrous pipe JIS G 5502 and JIS G 5705 for use with Item 5</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Item</td>
<td>Pipe and Fitting Materials</td>
<td>SERVICE A</td>
<td>SERVICE B</td>
<td>SERVICE C</td>
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<tr>
<td>7</td>
<td>Bronze sand casting grooved joint pressure fittings for non-ferrous pipe JIS H 5120, for use with Item 5</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>8</td>
<td>Wrought copper grooved joint pressure fittings for non-ferrous pipe JIS H 3250, Copper Rand Bores JIS H 3401 JIS H 3401 for use with Item 5</td>
<td>X</td>
<td>X</td>
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<tr>
<td>9</td>
<td>Malleable-iron threaded fittings, galvanized JIS B 2301 for use with Item 10</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>10</td>
<td>Steel pipe, seamless galvanized, JIS G 3452 Type S, Grade B</td>
<td>X</td>
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<tr>
<td>11</td>
<td>Seamless red brass pipe, JIS H 3300</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Item</td>
<td>Pipe and Fitting Materials</td>
<td>SERVICE A</td>
<td>SERVICE B</td>
<td>SERVICE C</td>
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<tr>
<td>12</td>
<td>Bronzed flanged fittings, JIS B 2240 for use with Items 11 and 14</td>
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<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>13</td>
<td>Cast copper alloy solder joint pressure fittings, JIS H 3401 for use with Item 14</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>14</td>
<td>Seamless copper pipe, JIS H 3300</td>
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<tr>
<td>15</td>
<td>Cast bronze threaded fittings, JIS H 3401</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>16</td>
<td>Copper drainage tube, (DWV), JIS H 3300</td>
<td>X*</td>
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<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>17</td>
<td>Wrought copper and wrought alloy solder-joint drainage fittings, JIS H 3401</td>
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<td>X</td>
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<tr>
<td>18</td>
<td>Cast copper alloy solder joint drainage fittings, DWV, JIS H 3401</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>19</td>
<td>Acrylonitrile-Butadiene (ABS) plastic drain, waste, and vent pipe and fittings, JIS H 3401</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### TABLE I

<table>
<thead>
<tr>
<th>Item #</th>
<th>Pipe and Fitting Materials</th>
<th>SERVICE A</th>
<th>SERVICE B</th>
<th>SERVICE C</th>
<th>SERVICE D</th>
<th>SERVICE E</th>
<th>SERVICE F</th>
<th>SERVICE G</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, JIS K 6739, JIS K 6742 (Sch 40) JIS K 6742</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>21</td>
<td>Process glass pipe and fittings, JIS R 3644</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>22</td>
<td>High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), JPF-DP-001</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Filament-wound reinforced thermosetting resin (RTRP) pipe, JIS K 7013</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**SERVICE:**

A - Underground Building Soil, Waste and Storm Drain  
B - Aboveground Soil, Waste, Drain In Buildings  
C - Underground Vent  
D - Aboveground Vent  
E - Interior Rainwater Conductors Aboveground  
F - Corrosive Waste And Vent Above And Belowground  
G - Condensate Drain Aboveground  

* - Hard Temper
<table>
<thead>
<tr>
<th>Item</th>
<th>Pipe and Fitting Materials</th>
<th>SERVICE A</th>
<th>SERVICE B</th>
<th>SERVICE C</th>
<th>SERVICE D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Malleable-iron threaded fittings:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Galvanized, JIS B 2301 for use with Item 4a</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>b. Same as &quot;a&quot; but not galvanized for use with Item 4b</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Grooved pipe couplings, ferrous pipe JIS G 5502 and JIS G 5705, non-ferrous pipe, JIS G 5502 and JIS G 5705</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ductile iron grooved joint fittings for ferrous pipe JIS G 5502 and JIS G 5705, for use with Item 2</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Steel pipe:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Seamless, galvanized, JIS G 3452, Type S, Grade B</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>b. Seamless, black, JIS G 3452, Type S, Grade B</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Seamless red brass pipe, JIS H 3300</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Bronze flanged fittings, JIS B 2240 for use with Items 5 and 7</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Seamless copper pipe, JIS H 3300</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Seamless copper water tube, JIS H 3300</td>
<td>X**</td>
<td>X**</td>
<td>X**</td>
<td>X***</td>
</tr>
<tr>
<td>9</td>
<td>Cast bronze threaded fittings, JIS H 3401 for use with Items 5 and 7</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Pipe and Fitting Materials</td>
<td>SERVICE A</td>
<td>SERVICE B</td>
<td>SERVICE C</td>
<td>SERVICE D</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>10</td>
<td>Wrought copper and bronze solder-joint pressure fittings, JIS H 3401 for use with Items 5, 7 and 8</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11</td>
<td>Cast copper alloy solder-joint pressure fittings, JIS H 3401 for use with Item 8</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>12</td>
<td>Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe JIS H 5120, for use with Item 2</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, JIS K 6761</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>15</td>
<td>Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, JIS K 6761</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>16</td>
<td>Butt fusion polyethylene (PE) plastic pipe fittings, JIS K 6743 for use with Items 14, 15, and 16</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>17</td>
<td>Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, JWWA K 144 and JWWA K 145 for use with Item 15</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>18</td>
<td>Polyethylene (PE) plastic tubing, JIS K 6761</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>19</td>
<td>Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, JIS K 6776</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### TABLE II

**PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS**

<table>
<thead>
<tr>
<th>Item #</th>
<th>Pipe and Fitting Materials</th>
<th>SERVICE A</th>
<th>SERVICE B</th>
<th>SERVICE C</th>
<th>SERVICE D</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, JIS K 6776</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>21</td>
<td>Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) JIS K 6776</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>22</td>
<td>Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, JIS K 6776, for use with Items 20, and 21</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>23</td>
<td>Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, JIS K 6776, for use with Items 20, 21, and 22</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>24</td>
<td>Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, JIS K 6776 for use with Items 20, 21, and 22</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>25</td>
<td>Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, JIS K 6741</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), JIS K 6741</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>27</td>
<td>Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, JIS K 6739</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>28</td>
<td>Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, JIS K 6739 for use with Items 26 and 27</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
## TABLE II

### PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

<table>
<thead>
<tr>
<th>Item #</th>
<th>Pipe and Fitting Materials</th>
<th>SERVICE A</th>
<th>SERVICE B</th>
<th>SERVICE C</th>
<th>SERVICE D</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, JIS K 6739</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>30</td>
<td>Joints for IPS PVC pipe using solvent cement, JWWA S 101</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>31</td>
<td>Steel pipeline flanges, JIS B 2220</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Fittings: brass or bronze; JIS H 3401 or JIS H 3401</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Carbon steel pipe unions, socket-welding and threaded, JIS B 2316</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Malleable-iron threaded pipe unions JIS B 2301</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Nipples, pipe threaded JIS B 2312</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Crosslinked Polyethylene (PEX) Plastic Pipe JIS K 6769</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>37</td>
<td>Press Fittings</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SERVICE:**
- A - Cold Water Service Aboveground
- B - Hot and Cold Water Distribution 82 degrees C Maximum Aboveground
- C - Compressed Air Lubricated
- D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.
- ** - Type L - Hard
- *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors
- **** - In or under slab floors only brazed joints
## TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

<table>
<thead>
<tr>
<th>FUEL</th>
<th>STORAGE CAPACITY LITERS</th>
<th>INPUT RATING</th>
<th>TEST PROCEDURE</th>
<th>REQUIRED PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. STORAGE WATER HEATERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elect.</td>
<td>227 max</td>
<td>ISO 14024</td>
<td>EF = 0.93</td>
<td></td>
</tr>
<tr>
<td>Elect.</td>
<td>227 min</td>
<td>ISO 14024</td>
<td>EF = 0.91</td>
<td></td>
</tr>
<tr>
<td>Elect.</td>
<td>75.7 min. 12 kW max.</td>
<td>ISO 14024</td>
<td>EF = 0.93-0.00132V minimum</td>
<td></td>
</tr>
<tr>
<td>Elect.</td>
<td>75.7 min. OR 12 kW min.</td>
<td>JIS S 2109</td>
<td>SL = 20+35x(V^1/2) maximum</td>
<td></td>
</tr>
<tr>
<td>Elect. Heat Pump</td>
<td>24 Amps or less and 250 Volts or less</td>
<td>ISO 14024</td>
<td>EF = 0.93-0.00132V</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>189 max</td>
<td>ISO 14024</td>
<td>EF = 0.67-0.0019V min</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>75.7 min. 22 kW max.</td>
<td>ISO 14024</td>
<td>EF = 0.80-0.0019V minimum</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>309.75 W/L max. 22 kW max.</td>
<td>JIS S 2109</td>
<td>ET = 80 percent; SL = 1.3+38/V max.</td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>75.7 min. 30.8 kW max.</td>
<td>ISO 14024</td>
<td>EF = 0.59-0.0019V min</td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>309.75 W/L max 30.8 kW</td>
<td>JIS S 2109</td>
<td>ET = 78 percent; SL = (Q/800+110x(V^1/2)) maximum</td>
<td></td>
</tr>
<tr>
<td>B. Unfired Hot Water Storage, R = 2.2 minimum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Instantaneous Water Heater</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>309.75 W/L min. 14.66 kW min.</td>
<td>ISO 14024</td>
<td>EF = 0.62-0.0019V and 7.57 L max 58.62 kW max.</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>309.75 W/L min. 58.62 kW min.</td>
<td>JIS S 2109</td>
<td>ET = 80 percent and 37.85 L max 58.62 kW max.</td>
<td></td>
</tr>
</tbody>
</table>
## TABLE III

<table>
<thead>
<tr>
<th>FUEL</th>
<th>STORAGE CAPACITY LITERS</th>
<th>INPUT RATING</th>
<th>TEST PROCEDURE</th>
<th>REQUIRED PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>309.75 W/L min.</td>
<td>58.62 kW min.</td>
<td>JIS S 2109</td>
<td>ET = 80 percent and 37.85 L min. SL + (Q/800+110x(V&lt;sup&gt;1/2&lt;/sup&gt;)</td>
</tr>
<tr>
<td>Oil</td>
<td>309.75 W/L min.</td>
<td>61.552 kW max.</td>
<td>ISO 14024</td>
<td>EF = 0.59-0.0019V and 37.85 L max.</td>
</tr>
<tr>
<td>Oil</td>
<td>309.75 W/L min.</td>
<td>61.552 kW max.</td>
<td>JIS S 2109</td>
<td>ET = 80 percent and 37.85 L min. SL + (Q/800+110x(V&lt;sup&gt;1/2&lt;/sup&gt;)</td>
</tr>
<tr>
<td>Oil</td>
<td>309.75 W/L min.</td>
<td>61.552 kW max.</td>
<td>JIS S 2109</td>
<td>ET = 78 percent and 37.85 L max. SL = (Q800+110x(V&lt;sup&gt;1/2&lt;/sup&gt;) )</td>
</tr>
</tbody>
</table>

### D. Pool Heater

Gas or Oil | All | All | ET = 78 percent
Heat Pump | All | All | COP = 4.0

### TERMS:

EF = Energy factor, minimum overall efficiency.
ET = Minimum thermal efficiency with 21 degrees C delta T.
SL = Standby loss is maximum Watts based on a 38.9 degrees C temperature difference between stored water and ambient requirements.
V = Rated storage volume in gallons
Q = Nameplate input rate in Watts

-- End of Section --
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

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    1.2.1.2 Diagrams
  1.2.2 Service Labeling
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1.3 SUBMITTALS
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    2.9.1.4 High Temperature Service Duct Connections
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        2.9.5.1.1.3 Blade Axles
2.9.5.1.1.4 Axle Bearings
2.9.5.1.1.5 Control Shaft/Hand Quadrant
2.9.5.1.1.6 Finish
2.9.5.1.2 Duct Height Greater than 300 mm
  2.9.5.1.2.1 Dampers
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  2.9.5.1.2.5 Axle Bearings
  2.9.5.1.2.6 Blade Actuator
  2.9.5.1.2.7 Blade Actuator Linkage
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  2.9.5.1.2.9 Finish
2.9.5.2 Round Dampers
  2.9.5.2.1 Frames
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  2.9.5.2.3 Blade Axles
  2.9.5.2.4 Axle Bearings
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  2.9.5.2.6 Finish
2.9.6 Automatic Balancing Dampers
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  2.9.12.1 Systems with total pressure above 1 kPa
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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)


ASTM INTERNATIONAL (ASTM)


NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)


UNDERWRITERS LABORATORIES (UL)

UL 555  (2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers

UL 555S  (2014; Reprint Aug 2016) UL Standard for Safety Smoke Dampers

---|---

JAPANESE INDUSTRIAL STANDARDS (JIS)

| JIS A 1400 | (2007) Radiators, Convectors and Similar Appliances-Methods of Performance Test |
| JIS A 4009 | (2017) Components of Air Duct |
| JIS A 9511 | (2017) Preformed Cellular Plastics Thermal Insulation Materials |
| JIS B 1518 | (2013) Rolling Bearings-Dynamic Load Ratings and Rating Life |
| JIS B 1521 | (2012) Rolling Bearings-Deep Groove Ball Bearings |
| JIS B 1534 | (2013) Rolling Bearings-Tapered Roller Bearings |
| JIS B 8616 | (2015) Package Air Conditioners |
| JIS B 8628 | (2017) Air to Air Heat and Energy Exchanger and Ventilators |
| JIS B 9927 | (1999) Cleanroom-Air Filters-Test Methods |
| JIS C 4203 | (2010) Single Phase Induction Motors for General Purpose (Amendment 1) |
| JIS C 4212 | (2010) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1) |
| JIS C 9603 | (1988) Ventilating Fans |
Performance

JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip

JIS G 3452 (2016) Carbon Steel Pipes for Ordinary Piping (Amendment 1)

JIS G 3553 (2011) Crimped Wire Cloth (Amendment 1)

JIS G 4305 (2015) Cold-Rolled Stainless Steel Plate, Sheet and Strip (Amendment 1)

JIS H 3100 (2018) Copper and Copper Alloy Sheets, Plates and Strips

JIS H 3300 (2018) Copper and Copper Alloy Seamless Pipes and Tubes

JIS H 4000 (2017) Aluminium and Aluminium Alloy Sheets, Strips and Plates (Amendment 1)

JIS H 8610 (1999) Electroplated-Coatings of Zinc on Iron or Steel

JIS H 8641 (2007) Hot Dip Galvanized Coatings

JIS HB 71 (2019) Electrical Safety

JIS K 5600-5-5 (1999) Testing Methods for Paints- Part 5 : Mechanical Property of Film Section 5 : Scratch Hardness (Stylus Method)


JIS K 6741 (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipes


JIS Z 4812 (1995) HEPA Filters for Radioactive Aerosols


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1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams must be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. provide neat mechanical drawings provided with extruded aluminum frame under 3 mm glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide labels in accordance with the typical examples below:

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>LABEL AND TAG DESIGNATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air handling unit Number</td>
<td>AHU - [______]</td>
</tr>
</tbody>
</table>
Identify similar services with different temperatures or pressures. Where pressures could exceed 860 kilopascal, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. In long straight runs, locate labels at distances within eyesight of each other not to exceed 22 meter. All labels must be visible and legible from the primary service and operating area.

<table>
<thead>
<tr>
<th>For Bare or Insulated Pipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>for Outside Diameters of</td>
</tr>
<tr>
<td>13 thru [_____] mm</td>
</tr>
<tr>
<td>40 thru [_____] mm</td>
</tr>
<tr>
<td>65 mm and larger</td>
</tr>
</tbody>
</table>

1.2.3 Color Coding

Color coding of all piping systems must be in accordance with MLIT-M or the base standard.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G[, [_____]]
SD-03 Product Data

Fire Dampers

Automatic Smoke-Fire Dampers

Automatic Smoke Dampers

Air Handling Units; G[, [____]]

Room Fan-Coil Units; G[, [____]]

Coil Induction Units; G[, [____]]

Constant Volume, Single Duct Terminal Units; G[, [____]]

Variable Volume, Single Duct Terminal Units; G[, [____]]

Variable Volume, Single Duct, Fan-Powered Terminal Units; G[, [____]]

Dual Duct Terminal Units; G[, [____]]

Reheat Units; G[, [____]]

Energy Recovery Devices; G[, [____]]

Test Procedures Diagrams; G[, [____]]

SD-06 Test Reports

Performance Tests

Damper Acceptance Test; G[, [____]]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

Fire Dampers

Manual Balancing Dampers

Automatic Smoke-Fire Dampers

Automatic Smoke Dampers

Centrifugal Fans

In-Line Centrifugal Fans

Axial Flow Fans

Centrifugal Type Power Wall Ventilators

Centrifugal Type Power Roof Ventilators

Propeller Type Power Roof Ventilators

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Air-Curtain Fans
Ceiling Exhaust Fans
Air Handling Units
Room Fan-Coil Units
Coil Induction Units
Constant Volume, Single Duct Terminal Units
Variable Volume, Single Duct Terminal Units
Variable Volume, Single Duct, Fan-Powered Terminal Units
Dual Duct Terminal Units
Reheat Units
Unit Ventilators
Energy Recovery Devices
Hydronic Modular Panels
Prefabricated Radiant-Heating Electric Panels

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Submit a written certificate from any recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the JIS a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with JIS H 8641 for exterior locations
and cadmium-plated in conformance with JIS H 8610 for interior locations. [Provide written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. Include illustrations of product markings, and the number of each type of bolt to be furnished in the certification.]

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be Refrigerant Handling Technician (Reibai-Furontou-Toriatsukai-Gijutsusha). Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4.4 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.5 Test Procedures

Submit proposed test procedures and test schedules for the [ductwork leak test, and] performance tests of systems, at least 2 weeks prior to the start of related testing.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory
field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization located in Japan.

2.2 STANDARD PRODUCTS

Except for the fabricated duct, plenums and casings specified in paragraphs "Metal Ductwork" and "Plenums and Casings for Field-Fabricated Units", provide components and equipment that are standard products of manufacturers regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. This requirement applies to all equipment, including diffusers, registers, fire dampers, and balancing dampers.

a. Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

b. Prior to this two year period, these standard products must have been sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures must have been copyrighted documents or have been identified with a manufacturer's document number.

c. Provide equipment items that are supported by a service organization.

2.3 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Provide identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates 40 mm that are high and smaller must be 1.6 mm thick, with engraved lettering 3 mm high; identification plates larger than 40 mm high must be 3 mm thick, with engraved lettering of suitable height. Identification plates 40 mm high and larger must have beveled edges. Install identification plates using a compatible adhesive.

2.4 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard. The requirements for [catwalks,] [operating platforms,] [ladders,] [and] [guardrails] are specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.5 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not
shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with JIS C 4203.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212.

d. Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

e. [Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 7.45 kW or less and adjustable frequency drives for larger motors.]

2.6 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts must not degrade the surrounding concrete.

2.7 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in JBE-S

2.8 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.9 DUCT SYSTEMS

2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with MLIT-M.

2.9.1.1 Metallic Flexible Duct

a. Provide duct that conforms to MLIT-M with factory-applied insulation,
vapor barrier, and end connections. Provide ducts designed for working pressures of 497 Pa and 373 Pa. Provide flexible round duct length that does not exceed 1525 mm. Secure connections by applying adhesive for 51 mm over rigid duct, apply flexible duct 51 mm over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of 25 mm thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.9.1.2 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 1.5 m. Provide runouts that are preinsulated, factory fabricated. Provide either field or factory applied vapor barrier. Provide not less than 0.60 L glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.9.1.3 General Service Duct Connectors

Provide a flexible duct connector approximately 150 mm in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods.

2.9.1.4 High Temperature Service Duct Connections

Provide material that is approximately 2.38 mm thick, 1.2 to 1.36 kg per square meter weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 650 degrees C.

2.9.1.5 Aluminum Ducts

JIS H 4000, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.9.1.6 Copper Sheets

JIS H 3100, light cold rolled temper.
2.9.1.7 Corrosion Resisting (Stainless) Steel Sheets

JIS G 4305

2.9.2 Duct Access Doors

Provide hinged access doors conforming to MLIT-M in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 375 by 450 mm, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 600 by 600 mm or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.9.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide [curtain type with damper blades] [in the air stream] [out of the air stream] or [single blade type] or [multi-blade type] fire dampers. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of fire dampers according to paragraph Fire Damper Acceptance Test and NFPA 90A.

2.9.4 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 300 mm. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.
2.9.5 Manual Balancing Dampers

a. Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators.

b. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 300 mm. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide access doors or panels in hard ceilings, partitions and walls for access to all concealed damper operators and damper locking setscrews. Coordinate location of doors or panels with other affected contractors.

c. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.9.5.1 Square or Rectangular Dampers

2.9.5.1.1 Duct Height 300 mm and Less

2.9.5.1.1.1 Frames

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Galvanized Steel Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 483 mm</td>
<td>Maximum 300 mm</td>
<td>Minimum 0.91 mm</td>
<td>Minimum 75 mm</td>
</tr>
<tr>
<td>More than 483 mm</td>
<td>Maximum 300 mm</td>
<td>Minimum 1.6 mm</td>
<td>Minimum 75 mm</td>
</tr>
</tbody>
</table>

2.9.5.1.1.2 Single Leaf Blades

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Galvanized Steel Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 483 mm</td>
<td>Maximum 300 mm</td>
<td>Minimum 0.91 mm</td>
<td>Minimum 75 mm</td>
</tr>
<tr>
<td>More than 483 mm</td>
<td>Maximum 300 mm</td>
<td>Minimum 1.6 mm</td>
<td>Minimum 75 mm</td>
</tr>
</tbody>
</table>

2.9.5.1.1.3 Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Provide axle shafts that extend through standoff bracket and hand quadrant.
### 2.9.5.1.1.4 Axle Bearings

Support the shaft on each end at the frames with shaft bearings. Press fit shaft bearings configuration to provide a tight joint between blade shaft and damper frame.

<table>
<thead>
<tr>
<th>Width</th>
<th>Height</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum 483 mm</td>
<td>Maximum 300 mm</td>
<td>Galvanized Steel, minimum 10 mm</td>
</tr>
<tr>
<td>More than 483 mm</td>
<td>Maximum 300 mm</td>
<td>Galvanized Steel, minimum 13 mm</td>
</tr>
</tbody>
</table>

### 2.9.5.1.1.5 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Provide a minimum stand-off distance of 50 mm off the metal duct surface. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

### 2.9.5.1.1.6 Finish

Mill Galvanized

### 2.9.5.1.2 Duct Height Greater than 300 mm

#### 2.9.5.1.2.1 Dampers

Provide dampers with multi-leaf opposed-type blades.

#### 2.9.5.1.2.2 Frames

Maximum 1200 mm in height; maximum 1200 mm in width; minimum of 1.6 mm galvanized steel, minimum of 127 mm long.

#### 2.9.5.1.2.3 Blades

Minimum of 1.6 mm galvanized steel; 150 mm nominal width.
2.9.5.1.2.4 Blade Axles

To support the blades of round dampers, provide galvanized square steel shafts supporting the blade the entire duct diameter frame-to-frame. Provide axle shafts that extend through standoff bracket and hand quadrant.

2.9.5.1.2.5 Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Press fit shaft bearings configuration to provide a tight joint between blade shaft and damper frame.

2.9.5.1.2.6 Blade Actuator

Minimum 50 mm diameter galvanized steel.

2.9.5.1.2.7 Blade Actuator Linkage

Mill Galvanized steel bar and crank plate with stainless steel pivots.

2.9.5.1.2.8 Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Provide a minimum stand-off distance of 50 mm off the metal duct surface. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.9.5.1.2.9 Finish

Mill Galvanized

2.9.5.2 Round Dampers

2.9.5.2.1 Frames

<table>
<thead>
<tr>
<th>Size</th>
<th>Galvanized Steel Thickness</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 to 500 mm</td>
<td>Minimum 0.91 mm</td>
<td>Minimum 152 mm</td>
</tr>
<tr>
<td>550 to 750 mm</td>
<td>Minimum 0.91 mm</td>
<td>Minimum 250 mm</td>
</tr>
<tr>
<td>775 to 1000 mm</td>
<td>Minimum 1.6 mm</td>
<td>Minimum 250 mm</td>
</tr>
</tbody>
</table>
2.9.5.2.2  Blades

<table>
<thead>
<tr>
<th>Size</th>
<th>Galvanized Steel Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 to 500 mm</td>
<td>Minimum 0.91 mm</td>
</tr>
<tr>
<td>550 to 750 mm</td>
<td>Minimum 1.6 mm</td>
</tr>
<tr>
<td>775 to 1000 mm</td>
<td>Minimum 3.5 mm</td>
</tr>
</tbody>
</table>

2.9.5.2.3  Blade Axles

To support the blades of round dampers, provide galvanized steel shafts supporting the blade the entire duct diameter frame-to-frame. Provide axle shafts that extend through standoff bracket and hand quadrant.

<table>
<thead>
<tr>
<th>Size</th>
<th>Shaft Size and Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 to 500 mm</td>
<td>Minimum 10 mm square</td>
</tr>
<tr>
<td>550 to 750 mm</td>
<td>Minimum 13 mm square</td>
</tr>
<tr>
<td>775 to 1000 mm</td>
<td>Minimum 19 mm square</td>
</tr>
</tbody>
</table>

2.9.5.2.4  Axle Bearings

Support the shaft on each end at the frames with shaft bearings constructed of oil-impregnated bronze, or solid nylon, or a solid plastic equivalent to nylon. Press fit shaft bearings configuration to provide a tight joint between blade shaft and damper frame.

<table>
<thead>
<tr>
<th>Size</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 to 500 mm</td>
<td>solid nylon, or equivalent solid plastic, or oil-impregnated bronze</td>
</tr>
<tr>
<td>550 to 750 mm</td>
<td>solid nylon, or equivalent solid plastic, or oil-impregnated bronze</td>
</tr>
<tr>
<td>775 to 1000 mm</td>
<td>oil-impregnated bronze, or stainless steel sleeve bearing</td>
</tr>
</tbody>
</table>

2.9.5.2.5  Control Shaft/Hand Quadrant

Provide dampers with accessible locking-type control shaft/hand quadrant operators.

Provide stand-off mounting brackets, bases, or adapters for the locking-type quadrant operators on dampers installed on ducts to be thermally insulated. Provide a minimum stand-off distance of 50 mm off the metal duct surface. Provide stand-off mounting items that are integral
with the operator or standard accessory of the damper manufacturer.

2.9.5.2.6 Finish

Mill Galvanized

2.9.6 Automatic Balancing Dampers

Provide dampers as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.9.7 Automatic Smoke-Fire Dampers

Multiple blade type, 82 degrees C fusible fire damper link; smoke damper assembly to include [pneumatically powered][electric] damper operator. UL 555 as a 1.5 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Provide a leakage rating under UL 555S that is no higher than Class [II][ or ][III] at an elevated temperature Category B (121 degrees C for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 25 Pa with average duct velocities of 13 m/second.

2.9.8 Automatic Smoke Dampers

UL listed multiple blade type, supplied by smoke damper manufacturer, with [pneumatic][electric] damper operator as part of assembly. Qualified under UL 555S with a leakage rating no higher than Class [II][ or ][III] at an elevated temperature Category B (121 degrees C for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 25 Pa with average duct velocities of 13 m/second.

2.9.9 Air Supply And Exhaust Air Dampers

Provide outdoor air supply and exhaust air dampers that have a maximum leakage rate when tested in accordance with JIS A 4009 as required by MLIT-M, including maximum Damper Leakage for:

a. Climate Zones 1,2,6,7,8 the maximum damper leakage at 250 Pa for motorized dampers is 20 L/s per square m of damper area and non-motorized dampers are not allowed.

b. All other Climate Zones the maximum damper leakage at 250 Pa is 50 L/s per square m and for non-motorized dampers is 100 L/s per square m of damper area.

Dampers smaller than 600 mm in either direction may have leakage of 200 L/s per square m.

2.9.10 Air Deflectors (Volume Extractors) and Branch Connections

Provide air deflectors (volume extractors) at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors (volume extractors), except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct.
When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors (volume extractors). Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors (volume extractors), also called turning vanes, in 90 degree elbows.

2.9.11 Plenums and Casings for Field-Fabricated Units

2.9.11.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in MLIT-M, as applicable. Construct system casing of not less than 1.6 mm galvanized sheet steel. Furnish cooling coil drain pans with 25 mm threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 1.6 mm steel, galvanized after fabrication or of 1.3 mm corrosion-resisting sheet steel conforming to JIS G 4305, welded and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 500 Pa greater than the maximum negative pressure in the coil space.

2.9.11.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in MLIT-M.

2.9.11.3 Access Doors

Provide access doors in each section of the casing. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 900 by 450 mm and locate them 450 mm above the floor. Where the space available does not accommodate doors of this size, use doors as large as the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

2.9.11.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than one mm galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 13 mm
under operation. Construct details, including joint sealing, not specifically covered, as indicated in MLIT-M. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.9.11.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.9.12 Sound Attenuation Equipment

2.9.12.1 Systems with total pressure above 1 kPa

Provide sound attenuators on the discharge duct of each fan operating at a total pressure above 1 kPa, and, when indicated, at the intake of each fan system. Provide sound attenuators elsewhere as indicated. Provide factory fabricated sound attenuators, tested by an independent laboratory for sound and performance characteristics. Provide a net sound reduction as indicated. Maximum permissible pressure drop is not to exceed 157 Pa. Construct traps to be airtight when operating under an internal static pressure of 2.5 kPa. Provide air-side surface capable of withstanding air velocity of 50 m/s. Certify that the equipment can obtain the sound reduction values specified after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Provide sound absorbing material conforming to JIS A 9511.

Provide sound absorbing material that meets the fire hazard rating requirements for insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For connection to ductwork, provide a duct transition section. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system can be provided if complying with requirements specified for factory fabricated sound attenuators, in lieu of factory fabricated sound attenuators. Construct the double-walled duct and fittings from an outer metal pressure shell of zinc-coated steel sheet, 25 mm thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Provide a sufficient length of run to obtain the noise reduction coefficient specified. Certify that the sound reduction value specified can be obtained within the length of duct run provided. Provide welded or spiral lock seams on the outer sheet metal of the double-walled duct to prevent water vapor penetration. Provide duct and fittings with an outer sheet that conforms to the metal thickness of high-pressure spiral and round ducts and fittings shown in MLIT-M. Provide acoustical insulation with a thermal conductivity "k" of not more than 0.0389 W/m-K at 24 degrees C mean temperature. Provide an internal perforated zinc-coated metal liner that is not less than 0.7 mm with perforations not larger than 6.35 mm in diameter providing a net open area not less than 10 percent of the surface.

2.9.12.2 System with total pressure of 1 kPa and Lower

Use sound attenuators only where indicated. Provide factory fabricated sound attenuators that are constructed of galvanized steel sheets. Provide attenuator with outer casing that is not less than 0.85 mm. Provide fibrous glass acoustical fill. Provide net sound reduction indicated. Obtain values on a test unit not less than 600 by 600 mm outside dimensions made by a certified nationally recognized independent acoustical laboratory. Provide air flow capacity as indicated or required. Provide pressure drop through the attenuator that does not exceed the value indicated, or that is not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less.
Acoustically test attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Include with the noise reduction data the effects of flanking paths and vibration transmission. Construct sound attenuators to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 500 Pa.

2.9.12.3 Acoustical Duct Liner

Use fibrous glass designed or flexible elastomeric duct liner for lining ductwork and conforming to the requirements of JIS A 9511, Type I and II. Provide uniform density, graduated density, or dual density liner composition, as standard with the manufacturer. Provide not less than 25 mm thick coated lining. Where acoustical duct liner is used, provide the thermal equivalent of the insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS for liner or combination of liner and insulation applied to the exterior of the ductwork. Increase duct sizes shown to compensate for the thickness of the lining used. [In lieu of sheet metal duct with field-applied acoustical lining, provide acoustically equivalent lengths of fibrous glass duct, elastomeric duct liner or factory fabricated double-walled internally insulated duct with perforated liner.]

2.9.13 Diffusers, Registers, and Grilles

Provide factory-fabricated units of [steel][corrosion-resistant steel][ or ][aluminum] that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 0.25 m/s in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to Japanese Industry Standards (JIS). Provide sound rated and certified inlets and outlets according to MLIT-M. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 2 m above the floor, protect them by a grille or screen.

2.9.13.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Construction for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.9.13.2 Perforated Plate Diffusers

Provide adjustable [one-way,] [two-way,] [three-way,][ ] [four-way] air pattern controls as indicated. Provide diffuser faceplates that do not sag
or deflect when operating under design conditions.

2.9.13.3 Linear Diffusers

Make joints between diffuser sections that appear as hairline cracks. Provide alignment slots for insertion of key strips or other concealed means to align exposed butt edges of diffusers. Equip with plaster frames when mounted in plaster ceiling. Do not use screws and bolts in exposed face of frames or flanges. Metal-fill and ground smooth frames and flanges exposed below ceiling. Furnish separate pivoted or hinged adjustable air-volume-damper and separate air-deflection blades.

2.9.13.4 Security Ceiling Diffusers

Provide diffusers that are steel with faceplate, fixed diffusion louvers, with flat surface margin, and an opposed blade damper. Provide faceplate that is 1.9 mm minimum with 13 by 13 mm holes on 5 mm spacing and a minimum free area of 45 percent.

2.9.13.5 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 150 mm below the ceiling unless otherwise indicated. Locate return and exhaust registers 150 mm above the floor unless otherwise indicated. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.9.13.6 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Provide volume dampers of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism must not project through any part of the register face. Automatic volume control devices are acceptable. Provide exhaust and return registers as specified for supply registers, except provide exhaust and return registers that have a single set of nondirectional face bars or vanes having the same appearance as the supply registers. Set face bars or vanes at [_____] degrees.

2.9.13.7 Security Supply Air Registers Except in Cells

Provide supply air registers, except in prisoner cells and prisoner holding cells, that are steel with individually adjustable horizontal and vertical vanes, perforated faceplate, flat surface margin and opposed blade damper. Put vertical vanes in front; with 19 mm o.c. vane spacing. Provide a 1.9 mm (minimum) perforated faceplate with 13 by 13 mm holes on 5 mm spacing and a minimum free area of 45 percent.

2.9.13.8 Security Return and Other Air Registers Except in Cells

Provide return, exhaust, transfer and relief air registers, except in prisoner cells and prisoner holding cells, that are steel with perforated faceplate, flat surface margin, opposed blade damper, and duct mounting sleeve. Provide 14 gage (minimum) faceplate with 13 by 13 mm holes on 5 mm
2.9.13.9 Security Supply Air Registers in Cells

Provide supply air registers in prisoner cells and prisoner holding cells that are steel with perforated faceplate, flat surface margin, extension sleeve, opposed blade damper, and back mounting flanges. Provide a 1.9 mm (minimum) faceplate with 13 by 13 mm holes on 5 mm spacing and a minimum free area of 45 percent. Provide a 14 gage (minimum) wall sleeve.

2.9.13.10 Security Return and Other Type Air Registers in Cells

Provide steel return, exhaust, transfer and relief air registers in prisoner cells and prisoner holding cells with perforated faceplate, flat surface margin, wall sleeve, opposed blade damper, and back mounting flanges. Provide 1.9 mm (minimum) faceplate with 13 by 13 mm holes on 5 mm spacing and a minimum free area of 45 percent. Provide a 14 gage (minimum) wall sleeve.

2.9.14 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section [07 60 00 FLASHING AND SHEET METAL] [08 91 00 METAL [WALL][ AND ] [DOOR] LOUVERS].

2.9.15 Air Vents, Penthouses, and Goosenecks

Fabricate air vents, penthouses, and goosenecks from galvanized steel [or aluminum] sheets with galvanized[ or aluminum] structural shapes. Provide sheet metal thickness, reinforcement, and fabrication that conform to MLIT-M. Accurately fit and secure louver blades to frames. Fold or bead edges of louver blades for rigidity and baffle these edges to exclude driving rain. Provide air vents, penthouses, and goosenecks with bird screen.

2.9.16 Bird Screens and Frames

Provide bird screens that conform to JIS G 3553, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.9.17 Radon Exhaust Ductwork

Fabricate radon exhaust ductwork installed in or beneath slabs from Schedule 40 PVC pipe that conforms to JIS K 6741. Use solvent cement conforming to JIS K 6741 to make joints. Otherwise provide metal radon exhaust ductwork as specified herein.

2.10 AIR SYSTEMS EQUIPMENT

2.10.1 Fans

Test and rate fans according to JIS B 8330. Calculate system effect on air moving devices in accordance with JIS B 8330 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to JIS B 8330 and rated
in accordance with JIS B 8330. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than [150] [ or 140] [ or 120] percent of the connected driving capacity. Provide variable pitch motor sheaves for 11 kW and below, and fixed pitch as defined by MLIT-M the fan shaft and the motor shaft. This is a non-adjustable speed. Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to JIS B 8330. Provide standard JIS C 9603, arrangement, rotation, and discharge as indicated.

2.10.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with JIS B 8330 as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 750 mm. Provide backward-inclined airfoil design fan blades for wheels over 750 mm in diameter. Provide open-wheel radial type booster fans for exhaust dryer systems, and fans suitable for conveying lint and the temperatures encountered. Equip the fan shaft with a heat slinger to dissipate heat buildup along the shaft. Install an access (service) door to facilitate maintenance to these fans. Provide fan wheels over 900 mm in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 900 mm or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than the requirement of JIS B 1518 as defined by JIS B 1521 and JIS B 1534. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Provide [[manually] automatically] operated inlet vanes on suction inlets. Provide [manually] automatically operated outlet dampers.] Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have [open] [dripproof] [totally enclosed] [explosion-proof] enclosures. [Provide [manual] [magnetic] [across-the-line] [reduced-voltage-start] type motor starters with [general-purpose] [weather-resistant] [watertight] enclosure.] [Provide remote manual switch with pilot indicating light where indicated.]

2.10.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and
adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than the requirement of JIS B 1518 as defined by JIS B 1521 and JIS B 1534. Provide motors with [open] [dripproof] [totally enclosed] [explosion-proof] enclosure. Provide [manual] [magnetic] motor starters across-the-line with [general-purpose] [weather-resistant] [explosion-proof] enclosures. Provide remote manual switch with pilot indicating light where indicated.

2.10.1.3 Axial Flow Fans

Provide axial flow fans complete with drive components and belt guard, with steel housing, cast fan wheel, cast or welded steel diffusers, fan shaft, bearings, and mounting frame as a factory-assembled unit. Provide fan wheels that are dynamically balanced and keyed to the fan shaft, with radially projecting blades of airfoil cross-section. Enclose and isolate fan bearings and drive shafts from the air stream. Permanently lubricate fan bearings or provide them with accessible grease fittings. Provide precision self-aligning ball or roller type fan bearings that are sealed against dust and dirt. Provide fan bearings that have a L50 rated bearing life at not less than the requirement of JIS B 1518 of operation as defined by and JIS B 1534. Provide fan inlets with an aerodynamically shaped bell and an inlet cone. Install diffuser or straightening vanes at the fan discharge to minimize turbulence and provide smooth discharge air flow. Furnish fan unit with [inlet and outlet flanges,] [inlet screen,] [duct equalizer section,] and [manual] [automatic] operation adjustable inlet vanes. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have [open] [dripproof] [totally enclosed] [explosion-proof] enclosure. Provide [manual] [magnetic] motor starters across-the-line with [general-purpose] [weather-resistant] [explosion-proof] enclosures. Provide remote manual switch with pilot indicating light where indicated.

2.10.1.4 Centrifugal Type Power Wall Ventilators

Provide [direct] [or] [V-belt] driven centrifugal type fans with backward inclined, non-overloading wheel. Provide removable and weatherproof motor housing. Provide unit housing that is designed for sealing to building surface and for discharge and condensate drippage away from building surface. Construct housing of heavy gauge aluminum. Equip unit with an [aluminum or plated steel wire discharge bird screen,] [disconnect switch,] [anodized aluminum] [stainless steel] wall grille,] [manufacturer's standard [gravity] [motor-operated] damper,] an airtight and liquid-tight metallic wall sleeve. Provide [totally enclosed fan cooled] [dripproof] [explosion-proof] type motor enclosure. Use only lubricated bearings.

2.10.1.5 Centrifugal Type Power Roof Ventilators

Provide [direct] [or] [V-belt] driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with [birdscreen,] [disconnect switch,] [gravity] [motorized] dampers,] [sound curb,] [roof curb,] and [extended base]. Provide [dripproof] [explosion-proof] type motor enclosure. Provide centrifugal type kitchen exhaust fans according to UL 705, fitted with V-belt drive, round hood, and windband upblast discharge configuration,
integral residue trough and collection device, with motor and power transmission components located in outside positively air ventilated compartment. Use only lubricated bearings.

2.10.1.6 Propeller Type Power Roof Ventilators

Provide [direct] or [V-belt] driven fans. Provide hinged or removable weathertight fan housing, fitted with framed rectangular base constructed of aluminum or galvanized steel. Provide [totally enclosed fan cooled] [explosion-proof] type motors. Furnish motors with nonfusible, horsepower rated, manual disconnect mount on unit. Furnish fans with [gravity] [motor operated] dampers, [birdscreen] [sound curb] [roof curb]. Use only lubricated bearings.

2.10.1.7 Air-Curtain Fans

Furnish air curtains with a weatherproof housing constructed of high impact plastic or minimum 1.3 mm rigid welded steel. Provide backward curved, non-overloading, centrifugal type fan wheels, accurately balanced statically and dynamically. Provide motors with totally enclosed fan cooled enclosures. Provide remote manual type motor starters with weather-resistant enclosure actuated when the doorway served is open. Provide air curtains that attain the air velocities specified within 2 seconds following activation. Provide bird screens at air intake and discharge openings. Provide air curtain unit or a multiple unit installation that is at least as wide as the opening to be protected. Provide the air discharge openings to permit outward adjustment of the discharge air. Place installation and adjust according to the manufacturer's written recommendation. Furnish directional controls on air curtains for service windows for easy clean or convenient removal. Design air curtains to prevent the adjustment of the air velocities specified. Make the interior surfaces of the air curtain units accessible for cleaning. Provide certified test data indicating that the fan can provide the air velocities required when fan is mounted as indicated. Provide air curtains designed for use in service entranceways that develop an air curtain not less than 75 mm thick at the discharge nozzle. Provide air velocity that is not less than 8 m/s across the entire entryway when measured 900 mm above the floor. [Provide air curtains designed for use on customer entranceways that develop an air curtain not less than 200 mm thick at the discharge opening. Provide velocity that is not less than 3 m/s across the entire entryway when measured 900 mm above the floor. Equip recirculating type air curtains with readily removable filters, or design the filters for in-position cleaning. Provide readily accessible and easily cleanable air capture compartment or design for in-position cleaning.] Provide air curtains designed for use on service windows that develop an air curtain not less than 200 mm thick at the discharge opening. Provide air velocity that is not less than 3 m/s across the entire opening of the service window measured 900 mm below the air discharge opening.

2.10.1.8 Ceiling Exhaust Fans

Provide centrifugal type, direct driven suspended cabinet-type ceiling exhaust fans. Provide fans with acoustically insulated housing. Provide chatter-proof backdraft damper. Provide egg-crate design or louver design integral face grille. Mount fan motors on vibration isolators. Furnish unit with mounting flange for hanging unit from above.
2.10.2 Coils

Provide fin-and-tube type coils constructed of seamless [copper][red brass] tubes and [aluminum][ or ][copper] fins mechanically bonded or soldered to the tubes. [Provide copper tube wall thickness that is a minimum of [0.406][0.508][0.6096] mm]. [Provide red brass tube wall thickness that is a minimum of [0.89][1.24] mm]. [Provide aluminum fins that are [0.14][0.19] mm minimum thickness.] [Provide copper fins that are 0.114 mm minimum thickness.] Provide casing and tube support sheets that are not lighter than 1.6 mm galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Mount coils for counterflow service. Rate and certify coils to meet the requirements of JIS B 8616.

2.10.2.1 Direct-Expansion Coils

Provide suitable direct-expansion coils for the refrigerant involved. Provide refrigerant piping that conforms to JIS H 3300 and clean, dehydrate and seal. Provide seamless copper tubing suction headers or seamless or resistance welded steel tube suction headers with copper connections. Provide supply headers that consist of a distributor which distributes the refrigerant through seamless copper tubing equally to all circuits in the coil. Provide circuited tubes to ensure minimum pressure drop and maximum heat transfer. Provide circuiting that permits refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Provide field installed coils which are completely dehydrated and sealed at the factory upon completion of pressure tests. Pressure test coils in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

2.10.2.2 Water Coils

Install water coils with a pitch of not less than 10 mm/m of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide removable water coils with drain pans. Pressure test coils in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

2.10.2.3 Steam Heating Coils

Construct steam coils from cast semisteel, welded steel or copper headers, and [red brass][copper] tubes. Construct headers from cast iron, welded steel or copper. Provide fin tube and header section that float within the casing to allow free expansion of tubing for coils subject to high pressure steam service. Provide each coil with a field or factory installed vacuum breaker. Provide single-tube type coils with tubes not less than 13 mm outside diameter, except for steam preheat coils. Provide supply headers that distribute steam evenly to all tubes at the indicated steam pressure. Factory test coils to ensure that, when supplied with a uniform face velocity, temperature across the leaving side is uniform with a maximum variation of no more than 5 percent. Pressure test coils in accordance with in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

2.10.2.4 Steam Preheat (Nonfreeze) Coils

Provide steam-distribution-tube type steam (nonfreeze) coils with condensing tubes not less than 25 mm outside diameter for tube lengths 1.5 m
and over and 13 mm outside diameter for tube lengths under 1.5 m. Construct headers from cast iron, welded steel, or copper. Provide distribution tubes that are not less than 15 mm outside diameter for tube lengths 1.5 m and over and 10 mm outside diameter for tube lengths under 1.5 m with orifices to discharge steam to condensing tubes. Install distribution tubes concentric inside of condensing tubes and hold securely in alignment. Limit maximum length of a single coil to 3.66 m. Factory test coils to ensure that, when supplied with a uniform face velocity, temperature across the leaving side is uniform with a maximum variation of no more than 5 percent. Pressure test coils in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

2.10.2.5 Electric Heating Coil

Provide an electric duct heater coil in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). Provide duct- or unit-mounted coil. Provide [nickel chromium resistor, single stage, strip] [nickel chromium resistor, single stage, strip or stainless steel, fin tubular] type coil. Provide coil with a built-in or surface-mounted high-limit thermostat interlocked electrically so that the coil cannot be energized unless the fan is energized. Provide galvanized steel or aluminum coil casing and support brackets. Mount coil to eliminate noise from expansion and contraction and for complete accessibility for service.

2.10.2.6 Eliminators

Equip each cooling coil having an air velocity of over 2 m/s through the net face area with moisture eliminators, unless the coil manufacturer guarantees, over the signature of a responsible company official, that no moisture can be carried beyond the drip pans under actual conditions of operation. Construct of minimum 24 gage [zinc-coated steel] [copper] [copper nickel] [or] [stainless steel], removable through the nearest access door in the casing or ductwork. Provide eliminators that have not less than two bends at 45 degrees and are spaced not more than 63 mm center-to-center on face. Provide each bend with an integrally formed hook as indicated in the JIS A 4009.

2.10.2.7 Sprayed Coil Dehumidifiers

Provide assembly with reinforced, braced, and externally insulated galvanized steel casing, vertical in-line spray pump, bronze self-cleaning spray nozzles, galvanized steel pipe spray headers, adjustable float valve with replaceable neoprene seat, manufacturer's standard cooling coil, and welded black steel drain tank. Provide overflow drain, make-up, and bleed connection.

2.10.2.8 Corrosion Protection for Coastal Installations

2.10.3 Air Filters

List air filters according to requirements of JIS B 9908-1, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of JIS B 9908-1.
2.10.3.1  Extended Surface Pleated Panel Filters

Provide 50 mm depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to JIS B 9908-1. Provide initial resistance at 2.54 m/s that does not exceed 0.09 kPa. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.10.3.2  Extended Surface Nonsupported Pocket Filters

Provide 750 mm depth, sectional, replaceable dry media type filters of the size indicated when tested according to JIS B 9908-1. Provide initial resistance at 2.54 m/s that does not exceed 0.1125 kPa. Provide fibrous glass media, supported in the airstream by a wire or non-woven synthetic backing and secured to a galvanized steel metal header. Provide pockets that do not sag or flap at anticipated air flows. Install each filter [with an extended surface pleated panel filter as a prefilter] in a factory preassembled, side access housing or a factory-made sectional frame bank, as indicated.

2.10.3.3  Cartridge Type Filters

Provide 305 mm depth, sectional, replaceable dry media type filters of the size indicated when tested according to JIS B 9908-1. Provide initial resistance at 2.54 m/s that does not exceed 0.14 kPa. Provide JIS Z 4812, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter with an extended surface pleated media panel filter as a prefilter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.10.3.4  Sectional Cleanable Filters

Provide 25[50] mm thick cleanable filters. Provide viscous adhesive in 20 L containers in sufficient quantity for 12 cleaning operations and not less than one L for each filter section. Provide one washing and charging tank for every 100 filter sections or fraction thereof; with each washing and charging unit consisting of a tank and [single][double] drain rack mounted on legs and drain rack with dividers and partitions to properly support the filters in the draining position.

2.10.3.5  Replaceable Media Filters

Provide the [dry-media][viscous adhesive] type replaceable media filters, of the size required to suit the application. Provide filtering media that is not less than 50 mm thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Enclose pad in a holding frame of not less than 1.6 mm galvanized steel, equipped with quick-opening mechanism for changing filter media. Base the air flow capacity of the filter on net filter face velocity not exceeding [1.5][_____] m/s, with initial resistance of [32][_____] Pa.

2.10.3.6  Automatic Renewable Media Filters

Provide the following:
a. Automatic, renewable media filters consisting of a horizontal or vertical traveling curtain of adhesive-coated bonded fibrous glass supplied in convenient roll form, and filter that does not require water supply, sewer connections, adhesive reservoir, or sprinkler equipment as part of the operation and maintenance requirements.

b. Basic frame that is fabricated of not less than 2 mm galvanized steel, and sectional design filters with each section of each filter fully factory assembled, requiring no field assembly other than setting in place next to any adjacent sections and the installation of media in roll form.

c. Each filter complete with initial loading of filter media drive motor adequate to handle the number of sections involved, and [painted steel] [stainless steel] control box containing a warning light to indicate media runout, a runout switch, and a Hand-Off-Auto selector switch.

d. Media feed across the filter face in [full-face increments] [increments] automatically controlled as determined by [filter pressure differential] [time interval control] [time interval control with pressure override] [photo electric control] to provide substantially constant operating resistance to airflow and varying not more than plus or minus 10 percent. Roll or enclose media in such a way that collected particulates can not re-entrain.

e. Rolls of clean media, no less than 19.8 m long, rerolled on disposable spools in the rewind section of the filter after the media has accumulated its design dirt load. Equip rewind section with a compression panel to tightly rewind used media for ease of handling. Provide media made of continuous, bonded fibrous glass material, UL Class 2, that does not compress more than 6 mm when subjected to air flow at 2.54 m/s. Factory charge media with an odorless and flame retardant adhesive which does not flow while in storage nor when subjected to temperatures up to 79.4 degrees C. Support media on both the leaving and entering air faces. Clean media must have initial resistance that does not exceed 45 Pa at its rated velocity of 2.54 m/s. Set control so that the resistance to air flow is between 100 and 125 Pa unless otherwise indicated.

f. Dust holding capacity, of 80 percent average arrestance under these operating conditions, when operating at a steady state with an upper operating resistance of 125 Pa, that is at least 592 (55) grams of ASHRAE Standard Test Dust per square meter of media area, when tested according to the dynamic testing provisions of JIS B 9908-1.

g. The horizontal type automatic renewable media filters, when used in conjunction with factory fabricated air handling units, that are dimensionally compatible with the connecting air handling units, and horizontal type filter housings with all exposed surfaces factory insulated internally with 25 mm, 24 kg/cubic meter density neoprene coated fibrous glass with thermal conductivity not greater than 0.04 W/m-K of thickness.

h. Access doors for horizontal filters with double wall construction as specified for plenums and casings for field-fabricated units in paragraph DUCT SYSTEMS.
2.10.3.7 Electrostatic Filters

Provide the following:

a. The combination dry agglomerator/extended surface, nonsupported pocket electrostatic filters or the combination dry agglomerator/automatic renewable, media (roll) type electrostatic filters, as indicated (except as modified). Supply each dry agglomerator electrostatic air filter with the correct quantity of fully housed power packs and equip with silicon rectifiers, manual reset circuit breakers, low voltage safety cutout, relays for field wiring to remote indication of primary and secondary voltages, with lamps mounted in the cover to indicate these functions locally. Equip power pack enclosure with external mounting brackets, and low and high voltage terminals fully exposed with access cover removed for ease of installation. Furnish interlock safety switches for each access door and access panel that permits access to either side of the filter, so that the filter is de-energized in the event that a door or panel is opened.

b. Ozone generation within the filter that does not exceed five parts per one hundred million parts of air. Locate high voltage insulators in a serviceable location outside the moving air stream or on the clean air side of the unit. Fully expose ionizer wire supports and furnish ionizer wires precut to size and with formed loops at each end to facilitate ionizer wire replacement.

c. Agglomerator cell plates that allow proper air stream entrainment of agglomerates and prevent excessive residual dust build-up, with cells that are open at the top and bottom to prevent accumulation of agglomerates which settle by gravity. Where the dry agglomerator electrostatic filter is indicated to be the automatic renewable media type, provide a storage section that utilizes a horizontal or vertical traveling curtain of adhesive-coated bonded fibrous glass for dry agglomerator storage section service supplied in 19.8 m lengths in convenient roll form. Otherwise, provide section construction and roll media characteristics as specified for automatic renewable media filters. Also a dry agglomerator/renewable media combination with an initial air flow resistance, after installation of clean media, that does not exceed 62.3 Pa at 2.54 m/s face velocity.

d. Where the dry agglomerator electrostatic filter is indicated to be of the extended surface nonsupported pocket filter type, provide a storage section as specified for extended surface non-supported pocket filters, with sectional holding frames or side access housings as indicated.

e. A dry agglomerator/extended surface nonsupported pocket filter section combination with initial air flow resistance, after installation of clean filters, that does not exceed 162 Pa at 2.54 m/s face velocity. Furnish front access filters with full height air distribution baffles and upper and lower mounting tracks to permit the baffles to be moved for agglomerator cell inspection and service. When used in conjunction with factory fabricated air handling units, supply side access housings which have dimensional compatibility.

2.10.3.8 High-Efficiency Particulate Air (HEPA) Filters

Provide HEPA filters that meet the requirements of JIS Z 4812 and are individually tested and certified to have an efficiency of not less than [95] [99.97] percent in accordance with JIS B 9927, and an initial
resistance at [_____] m/s that does not exceed [_____] Pa. Provide filters that are constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by corrugated aluminum or mineral-fiber inserts, strips of filter medium, or by honeycomb construction of the pleated filter medium. Provide interlocking, dovetailed, molded neoprene rubber gaskets of 5-10 durometer that are cemented to the perimeter of the [upstream] [downstream] face of the filter cell sides. Provide self-extinguishing rubber-base type adhesive or other materials conforming to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Provide filter cell sides that are [19 mm thick exterior grade fire-retardant plywood] [cadmium plated steel] [galvanized steel] assembled in a rigid manner. Provide overall cell side dimensions that are correct to 2 mm, and squareness that is maintained to within 3.2 mm. Provide holding frames that use spring loaded fasteners or other devices to seal the filter tightly within it and that prevent any bypass leakage around the filter during its installed life. Provide air capacity and the nominal depth of the filter as indicated. Install each filter in a factory preassembled side access housing or a factory-made sectional supporting frame as indicated. Provide prefilters of the type, construction and efficiency indicated.

2.10.3.9 Holding Frames

Fabricate frames from not lighter than 1.6 mm sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.

2.10.3.10 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Provide gauges that are at least 98 mm in diameter, with white dials with black figures, and [graduations] [graduated in 0.0025 kPa,] with a minimum range of 0.25 kPa beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 1.5 m minimum lengths of 6.35 mm diameter [aluminum] [vinyl] tubing, and all hardware and accessories for gauge mounting.

2.11 AIR HANDLING UNITS

2.11.1 Factory-Fabricated Air Handling Units

Provide [single-zone draw-through type][ or ] [single-zone blow-through type][ or ] [multizone blow-through type][blow-through double-deck type][blow-through triple deck type] units as indicated. Units must include fans, coils, airtight insulated casing, [prefilters,] [secondary filter sections,][ and ][diffuser sections where indicated,] [air blender] adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, [mixing box] [combination sectional filter-mixing box,] [pan][drysteam][spray type] humidifier[,] vibration-isolators, and appurtenances required for specified operation. Provide vibration isolators as indicated. Physical dimensions of each air handling unit must be suitable to fit space allotted to the unit with the capacity indicated. Provide air handling unit that is rated in accordance with JRA 4036.
2.11.1.1 Casings

Provide the following:

a. [Casing sections [[single] [50 mm double] wall type] [as indicated], constructed of a minimum 1.3 mm galvanized steel, or 1.3 mm corrosion-resisting sheet steel conforming to JIS G 4305.][Inner casing of double-wall units that are a minimum one mm solid galvanized steel or corrosion-resisting sheet steel conforming to JIS G 4305.] Design and construct casing with an integral insulated structural galvanized steel frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal must not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.

c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 1.3 mm outer and one mm inner panels made of either galvanized steel or corrosion-resisting sheet steel conforming to JIS G 4305. Provide rigid doors with heavy duty hinges and latches. Inspection doors must be a minimum 300 mm wide by 300 mm high. Access doors must be a minimum 600 mm wide, the full height of the unit casing or a minimum of 1800 mm, whichever is less. [Install a minimum 200 by 200 mm sealed glass window suitable for the intended application, in all access doors.]

d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of 1.4 mm [galvanized steel] [corrosion resisting sheet steel conforming to JIS G 4305.] Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils must not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Provide coils that are individually removable from the casing.

e. Insulate single-wall casing sections handling conditioned air with not less than 25 mm thick, 24 kg/cubic meter density coated fibrous glass material having a thermal conductivity not greater than 0.033 W/m-K. Insulate double-wall casing sections handling conditioned air with not less than 50 mm of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Seal double wall insulation completely by inner and outer panels.

f. Factory applied fibrous glass insulation that conforms to JIS A 9511, except that the minimum thickness and density requirements do not apply. Make air handling unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors [and casing sections].

g. Duct liner material, coating, and adhesive that conforms to fire-hazard
requirements specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Protect exposed insulation edges and joints where insulation panels are butted with a metal nosing strip or coat to meet erosion resistance requirements of JIS A 9511.

h. A latched and hinged inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections [_____][ where indicated].

2.11.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.11.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.11.1.4 Fans

Provide the following:

a. Fans that are double-inlet, centrifugal type with each fan in a separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.

b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by JIS B 1521 and JIS B 1534. Provide bearings that are permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.

c. Fans that are driven by a unit-mounted, or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Design belt drives for not less than a 1.3 service factor based on motor nameplate rating.

d. [Motor sheaves that are variable pitch for 20 kW and below and fixed pitch above 20 kW as defined by MLIT-M.] Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed shear after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with [open][splashproof][totally enclosed] enclosures.

e. Motor starters of [manual][magnetic][across-the-line][reduced-voltage-start] type with [general-purpose][weather-resistant][watertight] enclosure. Select
unit fan or fans to produce the required capacity at the fan static pressure with sound power level as indicated. Obtain the sound power level values according to JIS B 8330, JIS B 8330.

2.11.1.5 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

2.11.1.6 Diffuser Sections

Furnish diffuser sections between the discharge of all housed supply fans [and cooling coils of blow-through single zone units] [and ] [filter sections of those units with high efficiency filters located immediately downstream of the air handling unit fan section]. Provide diffuser sections that are fabricated by the unit manufacturer in a manner identical to the remainder of the unit casing, designed to be airtight under positive static pressures up to [2][_____] kPa and with an access door on each side for inspection purposes. Provide a diffuser section that contains a perforated diffusion plate, fabricated of galvanized steel, Type 316 stainless steel, aluminum, or steel treated for corrosion with manufacturer's standard corrosion-resisting finish, and designed to accomplish uniform air flow across the down-stream [coil][filters] while reducing the higher fan outlet velocity to within plus or minus 5 percent of the required face velocity of the downstream component.

2.12 TERMINAL UNITS

2.12.1 Room Fan-Coil Units

Provide base units that include galvanized coil casing, coil assembly drain pan [valve and piping package,] [outside air damper,] [wall intake box,] air filter, fans, motor, fan drive, motor switch, an enclosure for cabinet models and casing for concealed models, leveling devices integral with the unit for vertical type units, and sound power levels as indicated. Obtain sound power level data or values for these units according to test procedures based on JIS B 8616. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Fasten each unit securely to the building structure. Provide units with capacity indicated. Provide room fan-coil units that are certified as complying with MLIT-M, and meet the requirements of in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

2.12.1.1 Enclosures

Fabricate enclosures from not lighter than 1.3 mm steel, reinforced and braced. Provide enclosures with front panels that are removable and have 7 mm closed cell insulation or 13 mm thick dual density foil faced fibrous glass insulation. Make the exposed side of a high density, erosion-proof material suitable for use in air streams with velocities up to 23 m/s. Provide a discharge grille that is [adjustable] [fixed] and that is of such
design as to properly distribute air throughout the conditioned space. Plastic discharge and return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant and the material complies with the heat deflection criteria per in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). Provide galvanized or factory finished ferrous metal surfaces with corrosion resistant enamel, and access doors or removable panels for piping and control compartments, plus easy access for filter replacement. Provide duct discharge collar for concealed models.

2.12.1.2 Fans

Provide steel or aluminum, multiblade, centrifugal type fans. In lieu of metal, fans and scrolls could be of non-metallic materials of suitably reinforced compounds with smooth surfaces. Dynamically and statically balance the fans. Provide accessible assemblies for maintenance. Disassemble and re-assemble by means of mechanical fastening devices and not by epoxies or cements.

2.12.1.3 Coils

Fabricate coils from not less than 10 mm outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Provide coils with not less than 13 mm outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 2000 kPa or under water at 1700 kPa air pressure. Provide coils suitable for 1400 kPa working pressure. Make provisions for coil removal.

2.12.1.4 Drain Pans

Size and locate drain and drip pans to collect all water condensed on and dripping from any item within the unit enclosure or casing. Provide condensate drain pans designed for self-drainage to preclude the buildup of microbial slime and thermally insulated to prevent condensation and constructed of not lighter than 0.9 mm type 304 stainless steel or noncorrosive ABS plastic. Provide insulation with a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and of a waterproof type or coated with a waterproofing material. Design drain pans so as to allow no standing water and pitch to drain. Provide minimum 19 mm NPT or 15 mm OD drain connection in drain pan. Provide plastic or metal auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages; if metal, provide auxiliary pans that comply with the requirements specified above. Extend insulation at control and piping connections 25 mm minimum over the auxiliary drain pan.

2.12.1.5 Manually Operated Outside Air Dampers

Provide manually operated outside air dampers according to the arrangement indicated, and parallel airfoil type dampers of galvanized construction. Provide blades that rotate on stainless steel or nylon sleeve bearings.

2.12.1.6 Filters

Provide disposable type filter that complies with JIS B 9908-1. Provide filters in each unit that are removable without the use of tools.
2.12.1.7 Motors

Provide motors of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Provide motor switch with two or three speeds and off, manually operated, and mounted on an identified plate [inside the unit below or behind an access door] [or] [adjacent to the room thermostat] [as indicated]. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent is allowed. Provide motors with permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Provide a motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity that does not exceed the following values:

<table>
<thead>
<tr>
<th>Unit Capacity (L/S)</th>
<th>Free Discharge Motors</th>
<th>Maximum Power Consumption (Watts)</th>
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<tr>
<th>Unit Capacity (L/S)</th>
<th>High Static Motors</th>
<th>Maximum Power Consumption (Watts)</th>
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2.12.2 Coil Induction Units

Provide base unit that includes air plenums, air-discharge nozzles, air discharge grilles, recirculation grilles, water coil assembly, valve and piping package, condensate drain pan, and adjustable air-balancing dampers, plus an enclosure for cabinet models and casing for concealed models. Make each unit capable of producing not less than the capacity indicated without exceeding the indicated static pressure. Provide a sound power level as indicated with power level data or values for these units based on tests conducted according to JIS Z 8734. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. The values obtained for the standard cabinet models are acceptable for concealed models without separate tests, provided there is no variation between models as to coil configuration, air discharge nozzles, air balancing dampers, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Secure each unit to the building structure. Provide units with capacity indicated.

2.12.2.1 Enclosures

Fabricate enclosures from not lighter than 1.2 mm steel, reinforced and braced. Provide a removable front panel of enclosure and insulate when required acoustically and to prevent condensation. Provide discharge grilles that are [adjustable][integrally stamped] and properly distribute air throughout the conditioned space. Plastic discharge and return grilles are not acceptable. Provide access doors for all piping and control compartments.

2.12.2.2 Air Plenums

Fabricate plenums from galvanized steel with interior acoustically baffled and lined with sound absorbing material to attenuate the sound power from the primary air supply to the room. Provide heat-resistant nozzles that are integral with or attached airtight to the plenum. Where coil induction units are supplied with vertical runouts, furnish a streamlined, vaned, mitered elbow transition piece for connection between the unit and ductwork. Provide an adjustable air-balancing damper in each unit.

2.12.2.3 Coils

Fabricate coils from not less than 10 mm outside diameter seamless copper tubing, with copper or aluminum fins, mechanically bonded or soldered to the tubes. Furnish coil connections with not less than 13 mm outside diameter flare or sweat connectors, accessory piping package with terminal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 2000 kPa or under water at 1700 kPa air pressure and provide coils suitable for 1400 kPa working pressure.
2.12.2.4 Screens

Provide easily accessible lint screens or throwaway filters for each unit.

2.12.2.5 Drain Pan

Size and locate drain and drip pans to collect condensed water dripping from any item within the unit enclosure. Provide drain pans constructed of not lighter than 0.9 mm steel, galvanized after fabrication, and thermally insulated to prevent condensation. Provide insulation that has a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and that is a waterproof type or coated with a waterproofing material. In lieu of the above, drain pans constructed of die-formed 0.8 mm steel are allowed, formed from a single sheet and galvanized after fabrication and insulated and coated as for the 0.9 mm steel material or of die-formed 0.9 mm type 304 stainless steel insulated as specified above. Pitch drain pans to drain. Provide drain connection when a condensate drain system is indicated. Make connection a minimum 19 mm NPT or 15 mm OD.

2.12.3 Variable Air Volume (VAV) and Dual Duct Terminal Units

a. Provide VAV and dual duct terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. For each VAV terminal unit, provide a temperature sensor in the unit discharge ductwork.

b. Provide unit enclosures that are constructed of galvanized steel not lighter than 0.85 mm or aluminum sheet not lighter than 1.3 mm. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.

c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to JRA 4036 with the calculations prepared in accordance with JIS B 8616. Provide sound power level as indicated. Show discharge sound power for minimum and [375][_____] Pa inlet static pressure.

2.12.3.1 Constant Volume, Single Duct Terminal Units

Provide constant volume, single duct, terminal units that contain within the casing, a constant volume regulator. Provide volume regulators that control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 200 to 1500 Pa.

2.12.3.2 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 200 to 1500 Pa. Provide units with an internal resistance not exceeding 100 Pa at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 250 Pa range.
2.12.3.3 Variable Volume, Single Duct, Fan-Powered Terminal Units

Provide variable volume, single duct, fan-powered terminal units with a calibrated air volume sensing device, air valve or damper, actuator, fan and motor, and accessory relays. Provide units that control primary air volume to within plus or minus 5 percent of each air set point as determined by the thermostat with variations in inlet pressure from 200 to 1500 Pa. Provide unit fan that is centrifugal, direct-driven, double-inlet type with forward curved blades. Provide either single speed with speed controller or three-speed, permanently lubricated, permanent split-capacitor type fan motor. Isolate fan/motor assembly from the casing to minimize vibration transmission. Provide factory furnished fan control that is wired into the unit control system. Provide a factory-mounted pressure switch to operate the unit fan whenever pressure exists at the unit primary air inlet or whenever the control system fan operates.

2.12.3.4 Dual Duct Terminal Units

Provide dual duct terminal units with hot and cold inlet valve or dampers that are controlled in unison by single or dual actuators. Provide actuator as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Provide unit that controls delivered air volumes within plus or minus 5 percent with inlet air variations from 250 to 2000 Pa in either duct. Include mixing baffles with the unit casing. Provide cabinet and closed duct leakage that does not exceed 2 percent of maximum rated air volume. Provide units with an internal resistance that does not exceed [_____] Pa at maximum flow range.

2.12.3.5 Reheat Units

2.12.3.5.1 Hot Water Coils

Provide fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 1.6 mm, galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive pressure drop and are drainable where required or indicated. At the factory, test each coil at not less than 1700 kPa air pressure and provide coils suitable for 1400 kPa working pressure. Install drainable coils in the air handling units with a pitch of not less than 10 mm per m of tube length toward the drain end. Coils must conform to the provisions of JIS B 8616.

2.12.3.5.2 Steam Coils

Provide steam coils constructed of cast semisteel, welded steel, or copper headers, red-brass or copper tubes, and copper or aluminum fins mechanically bonded or soldered to the tubes. Roll and bush, braze or weld tubes into headers. Provide coil casings and tube support sheets, with collars of ample width, that are not lighter than 1.6 mm galvanized steel formed to provide structural strength. When required, furnish multiple tube supports to prevent tube sag. Float the fin tube and header section within the casing to allow free expansion of tubing for coils subject to high pressure steam service. Provide coils that are factory pressure tested and capable of withstanding 1700 kPa hydrostatic test pressure or 1400 kPa air pressure, and are for [700] [1400] kPa steam working pressure. Provide steam-distribution tube type preheat coils with
condensing tubes having not less than 15 mm outside diameters. Provide distribution tubes that have not less than 10 mm outside diameter, with orifices to discharge steam to condensing tubes. Install distribution tubes concentric inside of condensing tubes held securely in alignment. Limit the maximum length of a single coil to 120 times the diameter of the outside tube. Other heating coils must be single tube type with an outside diameter not less than 13 mm. Provide supply headers that distribute steam evenly to all tubes at the indicated steam pressure. Provide coils that conform to the provisions of JIS B 8616.

2.12.3.5.3 Electric Resistance Heaters

Provide the duct-mounting type electric resistance heaters consisting of a nickel-chromium resistor mounted on refractory material and a steel or aluminum frame for attachment to ductwork. Provide electric duct heater that meets the requirement of JIS C 9803 and is provided with a built-in or surface-mounted high-limit thermostat. Interlock electric duct heaters electrically so that they cannot be energized unless the fan is running.

2.12.4 Unit Ventilators

Provide unit ventilators that include an enclosure, [galvanized casing,] [cold-rolled steel casing with corrosion resistant coating,] coil assembly, [resistance heating coil assembly,] [valve and piping package,] drain pan, air filters, fan assembly, fan drive, motor, motor controller, dampers, damper operators, and sound power level as indicated. Obtain sound power level data or values for these units according to test procedures based on MLIT-M. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles, when handling standard flow for which the unit air capacity is rated. Secure each unit to the building structure. Provide the unit ventilators with capacity indicated. Provide the year-round classroom type unit ventilator with automatic controls arranged to properly heat, cool, and ventilate the room. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.12.4.1 Enclosures

Fabricate enclosures from not lighter than 1.6 mm galvanized steel, reinforced and braced, or all welded framework with panels to provide equivalent strength. Provide casing that is acoustically and thermally insulated internally with not less than 13 mm thick dual density fibrous glass insulation. Make the exposed side a high density, erosion-proof material suitable for use in air streams with velocities up to 246 m/s. Fasten the insulation with waterproof, fire-resistant adhesive. Design front panel for easy removal by one person. Provide discharge grilles that [have adjustable grilles or grilles with adjustable vanes and] properly distribute air throughout the conditioned space. Provide return grilles that are removable where front panel does not provide access to interior components. Plastic discharge or return grilles are not acceptable. Furnish removable panels or access doors for all piping and control compartments. Provide fan switch that is key operated or accessible through a locked access panel. Install gaskets at the back and bottom of the unit for effective air seal, as required.

2.12.4.2 Electric Resistance Heating Elements

Provide electric resistance heating elements that are of the sheathed, finned, tubular type, or of the open resistance type designed for direct
exposure to the air stream. Provide heating element electrical characteristics as indicated. Where fan motor or control voltage is lower than required for the electric-resistance heating element, install a fused factory mounted and wired transformer.

2.12.4.3 Fans

Provide fans that meet the requirements as specified in paragraph AIR SYSTEMS EQUIPMENT. Provide galvanized steel or aluminum, multiblade, centrifugal type fans, dynamically and statically balanced. Equip fan housings with resilient mounted, self-aligning permanently lubricated ball bearings, sleeve bearings, or combination ball and sleeve bearings, capable of not less than 2000 hours of operation on one oiling. Provide direct-connected fans.

2.12.4.4 Coils

Provide coils that are circuited for a maximum water velocity of 2.4 m/s without excessive pressure drop and are otherwise as specified for hot water coils in paragraph TERMINAL UNITS.

2.12.4.5 Drain Pans

Size and locate drain and drip pans to collect all condensed water dripping from any item within the unit enclosure. Provide drain pans constructed of not lighter than 1.2 mm steel, galvanized after fabrication, and thermally insulated to prevent condensation. Provide insulation that is coated with a fire-resistant waterproofing material. In lieu of the above, drain pans constructed of die-formed 1.0 mm steel is allowed, formed from a single sheet and galvanized after fabrication and insulated and coated as for the 1.3 mm steel material, or of die-formed 1.3 mm type 304 stainless steel insulated as specified above. Pitch drain pans to drain. Furnish drain connection unless otherwise indicated. Make the minimum connection 19 mm NDT or 18 mm OD.

2.12.4.6 Filters

Disposable type rated in accordance with ASHRAE 52.2, installed upstream of coil.

2.12.4.7 Dampers

Provide an outside air proportioning damper on each unit. In addition, provide a vane to prevent excessive outside air from entering unit and to prevent blow-through of outside air through the return air grille under high wind pressures. Where outside air and recirculated air proportioning dampers are provided on the unit, an additional vane is not required. Provide face and bypass dampers for each unit to ensure constant air volume at all positions of the dampers. Furnish each unit with a factory installed control cam assembly, pneumatic motor, or electric motor to operate the face and bypass dampers and outside air damper or outside air and recirculated air dampers in the sequence as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.12.4.8 Motors

Provide permanent split-capacitor type motors with built-in thermal overload protection and automatic reset. Mount motor on a resilient mounting, isolated from the casing and suitable for operation on electric
service available. Provide a manually operated motor switch that provides
for 2 or 3 speeds and off, mounted on an identified plate [inside the unit
below or behind an access door][or ][adjacent to the room thermostat][as
indicated]. In lieu of speed control, provide a solid state variable speed
controller having minimum speed reduction of 50 percent.

2.12.4.9 Outside Air Intakes

Provide the manufacturer's standard design outside air intakes furnished
with 13 mm mesh bird screen or louvers on 13 mm centers.

2.13 ENERGY RECOVERY DEVICES

2.13.1 Rotary Wheel

Provide unit that is a factory fabricated and tested assembly for
air-to-air energy recovery by transfer of sensible heat from exhaust air to
supply air stream, with device performance according to JIS B 8628 and that
delivers an energy transfer effectiveness of not less than [70][85][_____] percent
with cross-contamination not in excess of [0.1][1.0][_____] percent
of exhaust airflow rate at system design differential pressure, including
purging sector if provided with wheel. Provide exchange media that is
chemically inert, moisture-resistant, fire-retardant, laminated,
nonmetallic material which complies with NFPA 90A. Isolate exhaust and
supply streams by seals which are static, field adjustable, and
replaceable. Equip chain drive mechanisms with ratcheting torque limiter
or slip-clutch protective device. Fabricate enclosure from galvanized
steel and include provisions for maintenance access. Provide recovery
control and rotation failure provisions as indicated.

2.13.2 Run-Around-Coil

Provide assembly that is factory fabricated and tested air-to-liquid-to-air
energy recovery system for transfer of sensible heat from exhaust air to
supply air stream and that delivers an energy transfer effectiveness not
less than that indicated without cross-contamination with maximum energy
recovery at minimum life cycle cost. Computer optimize components for
capacity, effectiveness, number of coil fins per inch, number of coil rows,
flow rate, heat transfer rate of [_____] percent by volume of
[ethylene][propylene] glycol solution, and frost control. Provide coils
that conform to paragraph AIR HANDLING UNITS. Provide related pumps, and
piping specialties that conform to requirements of [Section 23 63 00.00 10
COLD STORAGE REFRIGERATION SYSTEMS][Section 23 57 10.00 10 FORCED HOT WATER
HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS][23 69 00.00 20
REFRIGERATION EQUIPMENT FOR COLD STORAGE] [_____]..

2.13.3 Heat Pipe

Provide a device that is a factory fabricated, assembled and tested,
counterflow arrangement, air-to-air heat exchanger for transfer of sensible
heat between exhaust and supply streams and that delivers an energy
transfer effectiveness not less than that indicated without
cross-contamination. Provide heat exchanger tube core that is [15][18][25]
mm nominal diameter, seamless aluminum or copper tube with extended
surfaces, utilizing wrought aluminum Alloy 3003 or Alloy 5052, temper to
suit. Provide maximum fins per unit length and number of tube rows as
indicated. Provide tubes that are fitted with internal capillary wick,
filled with a refrigerant complying with in accordance with Japanese
Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku), selected for
system design temperature range, and hermetically sealed. Refrigerants containing chlorofluorocarbons (CFC) are prohibited. Provide heat exchanger frame that is constructed of not less than 1.6 mm galvanized steel and fitted with intermediate tube supports, and flange connections. Provide tube end-covers and a partition of galvanized steel to separate exhaust and supply air streams without cross-contamination and in required area ratio. Provide a drain pan constructed of welded Type 300 series stainless steel.] Provide heat recovery regulation by [system face and bypass dampers and related control system as indicated][interfacing with manufacturer's standard tilt-control mechanism for summer/winter operation, regulating the supply air temperature and frost prevention on weather face of exhaust side at temperature indicated]. Coil must be fitted with pleated flexible connectors.

2.13.4 Desiccant Wheel

Provide counterflow supply, regeneration airstreams, a rotary type dehumidifier designed for continuous operation, and extended surface type wheel structure in the axial flow direction with a geometry that allows for laminar flow over the operating range for minimum air pressure differentials. Provide the dehumidifier complete with a drive system utilizing a fractional-horsepower electric motor and speed reducer assembly driving the rotor. Include a slack-side tensioner for automatic take-up for belt-driven wheels. Provide an adsorbing type desiccant material. Apply the desiccant material to the wheel such that the entire surface is active as a desiccant and the desiccant material does not degrade or detach from the surface of the wheel which is fitted with full-face, low-friction contact seals on both sides to prevent cross leakage. Provide rotary structure that has underheat, overheat and rotation fault circuitry. Provide wheel assembly with a warranty for a minimum of five years.

2.13.5 Plate Heat Exchanger

Provide energy recovery ventilator unit that is factory-fabricated for indoor installation, consisting of a flat plate cross-flow heat exchanger, cooling coil, supply air fan and motor and exhaust air fan and motor. The casing must be 1 mm G90, galvanized steel, double wall construction with 25 mm insulation. Provide fibrous desiccant cross-flow type heat exchanger core capable of easy removal from the unit.

2.14 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to JIS H 8641 or JIS G 3302. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to JIS Z 2371 JIS K 5600-7-9, and JIS K 5600-5-5 or JIS K 5600-5-6. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 3 mm. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to JIS H 8641.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.
2.15 SUPPLEMENTAL COMPONENTS/SERVICES

2.15.1 Chilled, Condenser, or Dual Service Water Piping

The requirements for chilled, condenser, or dual service water piping and accessories are specified in Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS.

2.15.2 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

2.15.3 Water or Steam Heating System Accessories

The requirements for water or steam heating accessories such as expansion tanks and steam traps are specified in Section 23 52 00 HEATING BOILERS[23 21 13.00 20 LOW TEMPERATURE WATER (LTW) HEATING SYSTEM][23 22 26.00 20 STEAM SYSTEM AND TERMINAL UNITS].

2.15.4 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE[23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS] except as modified herein.

2.15.5 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.15.6 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.15.7 Controls

The requirements for controls are specified in [Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS][ and ][Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][ and ][Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS].

2.16 RADIANT PANELS

2.16.1 Hydronic Modular Panels

2.16.1.1 Panels

Modular radiant panels will fit into a standard 600 mm x 600 mm or 600 mm x 1200 mm suspended T-Bar ceiling grid or flush mounted on a drywall ceiling. For flush mounted ceiling applications, the manufacturer will provide a one piece extruded aluminum frame. Panels shall be supported from the T-bar assembly. Panels shall be [14 gauge] or [16 gauge] extruded aluminum or sheet steel.
2.16.1.2 Heat Sink

The modular panels shall use extruded aluminum with integrated heat sinks on the back to transfer heat between copper tubes and the panel face.

2.16.1.3 Water Tubes

Tubes shall consist of JIS H 3300 [13 mm] [16 mm] O.D. nominal copper tubing. Water connections will be suitable for solder or compression fittings. Heat pads will be used between the soldered fitting and the panel to protect the panel surface. The manufacturer will provide water pressure drop data as well as heating output data derived from tests in accordance with JIS A 1400 (heating). The panels will have the capacity to have multiple passes with connections either on the [same end] or [opposite ends], dependent on the number of passes.

2.16.1.4 Finish

All visible components shall be powder coated with highly emissive powder coat polyester paint for optimal radiative properties as well as durability and easy cleaning. Standard finish color shall be white.

2.16.1.5 Performance

Manufacturer will provide water pressure drop data as well as heat and cool output data derived from tests in accordance with JIS A 1400 (heating).

2.16.1.6 Capacity

Modular radiant panel capacity will be tested and certified by manufacturer in accordance with JIS A 1400 (heating) to meet the required performance. Should any performance rating, chilled or hot water supply temperature, water pressure drop, etc. deviate from the schedule, the manufacturer will submit the updated capacity. [The manufacturer will have factory testing facility available to perform performance test of units in accordance with said standard.]

2.16.1.7 Water Connections

Connections will be shipped sealed to limit the introduction of dust and dirt during shipping and construction.

2.16.1.8 Installation

Panels will be installed as recommended by the manufacturer.

2.16.1.9 Accessories

Stainless steel braided hoses, 300 mm or 450 mm long will be supplied with the panels.

The top of the heating and cooling panels shall be covered with 38 mm thick 16kg/m3 formaldehyde-free fiber glass insulation with a minimum R = 0.79 m² deg C/W. The insulation shall be covered with a foil scrim kraft vapor barrier facing.
2.16.2 Hydronic Linear Panels

2.16.2.1 Panels

Linear radiant panels must use extruded aluminum with integrated heat sinks on the back to transfer heat between copper tubes and the panel face. The linear radiant panel is to radiate or absorb heat from or to the zone below. Panels must be [14 gauge] or [16 gauge] extruded aluminum.

2.16.2.2 Heat Sink

The modular panels must use extruded aluminum with integrated heat sinks on the back to transfer heat between copper tubes and the panel face.

2.16.2.3 Water Tubes

Tubes must consist of JIS H 3300 13 mm or 16mm O.D. nominal copper tubing. Water connections will be suitable for solder or compression fittings. The manufacturer will provide water pressure drop data as well as heating output data derived from tests in accordance with JIS A 1400 (heating).

2.16.2.4 Mounting

Units must be provided with mounting hardware as required for mounting in T-Bar applications or ceiling flush mounting. The manufacturer's standard hardware for mounting panels abutting each other must be submitted for approval.

2.16.2.5 Finish

All visible components must be powder coated with highly emissive powder coat polyester paint for optimal radiative properties as well as durability and easy cleaning. Standard finish color must be white.

2.16.2.6 Performance

Manufacturer must provide water pressure drop data as well as heat output data derived from tests in accordance with JIS A 1400(heating).

2.16.2.7 Capacity

Modular radiant panel capacity must be tested and certified by manufacturer in accordance with JIS A 1400(heating) to meet the required performance. Should any performance rating, chilled or hot water supply temperature, water pressure drop, etc. deviate from the schedule, the manufacturer must submit the updated capacity. The manufacturer must have factory testing facility available to perform performance test of units in accordance with said standard.

2.16.2.8 Water Connections

Connections will be shipped sealed to limit the introduction of dust and dirt during shipping and construction.

2.16.2.9 Accessories

Stainless steel braded hoses, 300 mm or 450 mm long will be supplied with the panels.
The top of the heating and cooling panels must be covered with 38 mm thick 16kg/m³ formaldehyde-free fiber glass insulation with a minimum R = 0.79 m²·deg C/W. The insulation must be covered with a foil scrim kraft vapor barrier facing.

2.16.3 Prefabricated Radiant-Heating Electric Panels

2.16.3.1 Description

Sheet metal enclosed panel with heating element suitable for [lay-in installation flush with T-bar ceiling grid] [or surface mounting] [or recessed mounting].

2.16.3.2 Panel

Minimum 0.7 mm thick, galvanized steel sheet back panel riveted to minimum 1.0 mm thick, galvanized steel sheet front panel with fused-on crystalline surface.

2.16.3.3 Heating Element

Powdered graphite sandwiched between sheets of electric insulation.

2.16.3.4 Electrical Connections

Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.

2.16.3.5 Exposed-Side Panel Finish

[Apply silk-screened finish to match appearance of Architect selected acoustical ceiling tiles.] [Baked-enamel finish in color as selected by Architect.]

2.16.3.6 Surface-Mounting Trim

Sheet metal with baked-enamel finish in color as selected by Architect.

2.16.3.7 Wall Thermostat

Bimetal, sensing elements; with contacts suitable for [low] [line]-voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.
b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of [910][_____] mm. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits JIS HB 71 (Electrical-Safety Related work practices) and an additional [910][_____] mm.

c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all [units]. Provide a depth of each seal of 50 mm plus 0.1 mm for each Pa, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 150 mm concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors. Submit foundation drawings as specified in paragraph DETAIL DRAWINGS. Provide concrete for foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.
3.2.5 Metal Ductwork

Install according to MLIT-M unless otherwise indicated. Install duct supports for sheet metal ductwork according to MLIT-M, unless otherwise specified. Do not use friction beam clamps indicated in MLIT-M. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.5.1 Underground Ductwork

Provide PVC plastisol coated galvanized steel underground ductwork with coating on interior and exterior surfaces and watertight joints. Install ductwork as indicated. Maximum burial depth is 2 m.

3.2.5.2 Radon Exhaust Ductwork

Perforate subslab suction piping where indicated. Install PVC joints.

3.2.5.3 Light Duty Corrosive Exhaust Ductwork

For light duty corrosive exhaust ductwork, use PVC plastisol coated galvanized steel with PVC coating on interior surfaces and epoxy wash primer coating on exterior surfaces.

3.2.6 FRP Ductwork

Provide fibrous glass reinforced plastic ducting and related structures that conform to JIS A 4009. Provide flanged joints where indicated. Crevice-free butt lay-up joints are acceptable where flanged joints are not indicated. When ambient temperatures are lower than 10 degrees C, heat cure joints by exothermic reaction heat packs.

3.2.7 Kitchen Exhaust Ductwork

3.2.7.1 Ducts Conveying Smoke and Grease Laden Vapors

Provide ducts conveying smoke and grease laden vapors that conform to requirements of NFPA 96. Make seams, joints, penetrations, and duct-to-hood collar connections with a liquid tight continuous external weld. Provide duct material that is a minimum 1.3 mm, Type 304L or 316L, stainless steel] [minimum 1.6 mm carbon steel]. [Include with duct construction an external perimeter angle sized in accordance with MLIT-M, except place welded joint reinforcement on maximum of 600 mm centers; continuously welded companion angle bolted flanged joints with flexible ceramic cloth gaskets where indicated; pitched to drain at low points; welded pipe coupling-plug drains at low points; welded fire protection and detergent cleaning penetration; steel framed, stud bolted, and flexible ceramic cloth gasketed cleaning access provisions where indicated. Make angles, pipe couplings, frames, bolts, etc., the same material as that specified for the duct unless indicated otherwise.]
3.2.7.2 Exposed Ductwork

Provide exposed ductwork that is fabricated from minimum 1.3 mm, Type 304L or 316L, stainless steel with continuously welded joints and seams. Pitch ducts to drain at hoods and low points indicated. Match surface finish to hoods.

3.2.7.3 Concealed Ducts Conveying Moisture Laden Air

Fabricate concealed ducts conveying moisture laden air from minimum [1.3 mm, Type 300 series, stainless steel] [1.6 mm, galvanized steel] [0.55 mm, tempered copper sheet]. Continuously weld, braze, or solder joints to be liquid tight. Pitch ducts to drain at points indicated. Make transitions to other metals liquid tight, companion angle bolted and gasketed.

3.2.7.4 Construction

Ducts shall be constructed of and supported by carbon steel not less than 1.37 mm in thickness or stainless steel not less than 1.09 mm in thickness. All seams, joints, penetrations shall have external weld except duct-to-hood collar connections shall not require a liquid tight continuous external weld as required in NFPA 96.

3.2.7.5 Access Panels

On vertical ductwork where personnel entry is possible, access shall be provided at the top of the vertical riser to accommodate descent. Where personnel entry is not possible, adequate access for cleaning shall be provided on each floor. The exhaust duct shall have a slope downstream of the exhaust air. Access panels shall be of the same material and thickness as the duct. Access panels shall have a gasket or sealant that is rated for 815.6 celsius degrees (1500 F) and shall be greaseltight. For hoods with dampers in the exhaust or supply collar, an access panel for cleaning and inspection shall be provided in the duct or the hood within 457 mm of the damper. Access panels shall be provided at the side or at the top of the duct, whichever is more accessible, and at changes of direction. Horizontal duct shall have access panels at 8 feet interval.

3.2.8 Acoustical Duct Lining

Apply lining in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C916, Type I, and manufacturer's reconnected material, NFPA 90A, UL 723, and ASTM E84. Provide top and bottom pieces that lap the side pieces and are secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to MLIT-M. Provide welded pins, cup-head pins, or adhered clips that do not distort the duct, burn through, nor mar the finish or the surface of the duct. Make pins and washers flush with the surfaces of the duct liner and seal all breaks and punctures of the duct liner coating with the nonflammable, fire resistant adhesive. Coat exposed edges of the liner at the duct ends and at other joints where the lining is subject to erosion with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Apply duct liner to flat sheet metal prior to forming duct through the sheet metal brake. Additionally secure lining at the top and bottom surfaces of the duct by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in MLIT-M to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, are acceptable.
3.2.9 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.10 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums [up to the point where the outdoor air reaches the conditioning unit] [or] [up to the point where the outdoor air mixes with the return air stream].

3.2.11 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.12 Power Roof Ventilator Mounting

Provide foamed 13 mm thick, closed-cell, flexible elastomer insulation to cover width of roof curb mounting flange. Where wood nailers are used, predrill holes for fasteners.

3.2.13 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 75 mm margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of [28][14][_____] calendar days before being loaded.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.
3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse [_____] protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 380 mm and smaller. Build framed, prepared openings for round duct larger than 380 mm and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide 25 mm clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with JIS A 9504, Type 1, Class B-2.

3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 1 mm thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with JIS G 3452, Schedule 20.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 1 mm galvanized steel, unless otherwise indicated.

3.6.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 16 degrees C, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.6.4 Closure Collars

Provide closure collars of a minimum 100 mm wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 380 mm in diameter or less from 1 mm galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 380 mm from 1.40 mm galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 380 mm or
less from 1 mm galvanized steel. Install collars with fasteners a maximum of 150 mm on center. Attach to collars a minimum of 4 fasteners where the opening is 300 mm in diameter or less, and a minimum of 8 fasteners where the opening is 500 mm in diameter or less.

3.6.5 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 50 degrees C. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.7.1 Temperatures less than 50 degrees C

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat to metal surfaces subject to temperatures less than 50 degrees C.

3.7.2 Temperatures between 50 and 205 degrees C

Apply two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm to metal surfaces subject to temperatures between 50 and 205 degrees C.

3.7.3 Temperatures greater than 205 degrees C

Apply two coats of heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm to metal surfaces subject to temperatures greater than 205 degrees C.

3.7.4 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

3.7.5 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 13 mm diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without
the use of tools and that do not separate from the ceiling panels when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 1 m wide, 750 mm high, and 13 mm thick. Make the board of wood fiberboard and frame under glass or 1.6 mm transparent plastic cover. Make the color code symbols approximately 19 mm in diameter and the related lettering in 13 mm high capital letters. Mount the color code board [where indicated] [in the mechanical or equipment room]. Make the color code system as indicated below:

<table>
<thead>
<tr>
<th>Color</th>
<th>System</th>
<th>Item</th>
<th>Location</th>
</tr>
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<tr>
<td>[_____]</td>
<td>[_____]</td>
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</table>

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 35 mm minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 2 mm diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.9 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils, [filters, etc.][filters, etc. designated as static pressure Class 750 Pa through Class 2500 Pa.] Provide test procedure, apparatus, and report that conform to JIS Z 2330. The maximum allowable leakage rate is [_____] L/s. Complete ductwork leak test with satisfactory results prior to applying insulation to ductwork exterior or concealing ductwork.

3.10 DUCTWORK LEAK TESTS

The requirements for ductwork leak tests are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.11 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.12 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution,
including controls, has been completed, with the exception of performance tests.

3.13 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Provide tests that cover a period of not less than [_____] days for each system and demonstrate that the entire system is functioning according to the specifications. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

Submit test reports for the [ductwork leak test, and] performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

3.14 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of [room fan-coil units][coil-induction units,] [unit ventilators,] thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and provide new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Perform and document that proper "Indoor Air Quality During Construction" procedures have been followed; provide documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.15 RADIANT PANELS

3.15.1 Installation

Install radiant panels level and plumb, maintaining sufficient clearance for normal services and maintenance.

3.15.2 Soldering

When soldering copper fittings at the panel, a heat pad will be used to protect the panel finish.
3.15.3 Connections

Install piping adjacent to radiant panels to allow for service and maintenance.

3.16 OPERATION AND MAINTENANCE

3.16.1 Operation and Maintenance Manuals

Submit [six] [_____] manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data.

3.16.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of [_____] hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --
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SECTION 23 05 15

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

<p>| JIS A 0203 | (2014) Concrete Terminology |
| JIS A 1108 | (2018) Method of Test for Compressive Strength of Concrete |
| JIS A 5758 | (2016) Sealants for Sealing and Glazing in Buildings |
| JIS B 1112 | (1995) Cross Recessed Head Wood Screws |
| JIS B 1181 | (2014) Hexagon Nuts and Hexagon Thin Nuts |
| JIS B 2011 | (2013) Bronze, Gate, Globe, Angle, and Check Valves (Amendment 2) |
| JIS B 2031 | (2015) Gray Cast Iron Valves (Amendment 1) |
| JIS B 2032 | (2013) Wafer Type Rubber-Seated Butterfly Valves |
| JIS B 2061 | (2017) Faucets, Ball Taps and Flush Valves |
| JIS B 2220 | (2012) Steel Pipe Flanges |
| JIS B 2239 | (2013) Cast Iron Pipe Flanges |
| JIS B 2240 | (2006) Copper Alloy Pipe Flanges |
| JIS B 2301 | (2013) Screwed Type Malleable Cast Iron Pipe Fittings |</p>
<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
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<tbody>
<tr>
<td>JIS B 2311</td>
<td>(2015) Steel Butt-Welding Pipe Fittings for Ordinary Use</td>
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<td>JIS B 2312</td>
<td>(2015) Steel Butt-Welding Pipe Fittings</td>
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<tr>
<td>JIS B 8267</td>
<td>(2015) Construction of Pressure Vessel</td>
</tr>
<tr>
<td>JIS B 8285</td>
<td>(2010) Welding Procedure Qualification Test for Pressure Vessels</td>
</tr>
<tr>
<td>JIS C 3605</td>
<td>(R2002) 600 V Polyethylene Insulated Cables, Type CV</td>
</tr>
<tr>
<td>JIS G 3138</td>
<td>(2005) Rolled Steel Bars for Building Structure</td>
</tr>
<tr>
<td>JIS G 3201</td>
<td>(2008) Carbon Steel Forgings for General Use (Amendment 1)</td>
</tr>
<tr>
<td>JIS G 3202</td>
<td>(2008) Carbon Steel Forgings for Pressure Vessels (Amendment 1)</td>
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<tr>
<td>JIS G 3454</td>
<td>(2019) Carbon Steel Pipes for Pressure Service (Amendment 1)</td>
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<tr>
<td>JIS G 3455</td>
<td>(2016) Carbon Steel Pipes for High Pressure Service</td>
</tr>
<tr>
<td>JIS G 3459</td>
<td>(2017) Stainless Steel Pipes (Amendment 1)</td>
</tr>
<tr>
<td>JIS G 4051</td>
<td>(2018) Carbon Steels for Machine Structural Use (Amendment 1)</td>
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<tr>
<td>JIS G 4053</td>
<td>(2018) Low-Alloyed Steels for Machine Structural Use (Amendment 1)</td>
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<tr>
<td>JIS G 4107</td>
<td>(2015) Alloy Steel Bolting Materials for High Temperature Service (Amendment 1)</td>
</tr>
<tr>
<td>JIS G 4303</td>
<td>(2012) Stainless Steel Bars</td>
</tr>
<tr>
<td>JIS G 4305</td>
<td>(2015) Cold-Rolled Stainless Steel Plate, Sheet and Strip (Amendment 1)</td>
</tr>
<tr>
<td>JIS G 5151</td>
<td>(1991) Steel Castings for High Temperature and High Pressure Service</td>
</tr>
</tbody>
</table>
1.2 GENERAL REQUIREMENTS

[Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section]

[Section 40 17 30.00 40 WELDING GENERAL PIPING applies to work specified in this section.

] Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, and warranty information.

Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for...
the Government.] Submittals with an "S" are for inclusion in the sustainability eNotebook, in conformance to Section 01 33 29 sustainability reporting. Submit the following in accordance with Section 01 33 00 submittal procedures:

SD-01 Preconstruction Submittals
- Material, Equipment, and Fixture Lists[ G]

SD-02 Shop Drawings
- Record Drawings[ G, [____]]
- Coordination Drawings[ G]

SD-10 Operation and Maintenance Data
- Operation and Maintenance Manuals[ ]

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Provide standard products in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Alternative Qualifications

Products having less than a two-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.3 Service Support

Ensure the equipment items are supported by service organizations located in Japan. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. Select service organizations that are reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.4 Manufacturer's Nameplate

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable.

1.4.5 Modification of References

In each of the publications referred to herein, consider the advisory
provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.4.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions are considered mandatory, the word "should" is interpreted as "shall." Reference to the "code official" is interpreted to mean the "Contracting Officer." For Navy owned property, interpret references to the "owner" to mean the "Contracting Officer." For leased facilities, references to the "owner" is interpreted to mean the "lessor." References to the "permit holder" are interpreted to mean the "Contractor."

1.4.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, are applied as appropriate by the Contracting Officer and as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer’s recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Provide instructors thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished is as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.7 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves,
expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 ELECTRICAL HEAT TRACING

Provide heat trace systems for pipes, valves, and fittings. System include all necessary components, including heaters and controls to prevent freezing.

Provide self-regulating heaters consisting of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature along its length. Ensure heater is able to be crossed over itself without overheating. Obtain approval before used directly on plastic pipe. Cover heater with a radiation cross-linked modified polyolefin dielectric jacket in accordance with JIS C 3605.

Provide heater with self-regulating factor of at least [90] percent, in order to provide energy conservation and to prevent overheating.

Operate heater on line voltages of [120] [208] volts without the use of transformers.

Size heater according to the following table:

<table>
<thead>
<tr>
<th>Pipe Size (DN)</th>
<th>Minus 23 degrees C</th>
<th>Minus 29 degrees C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16 watts per meter (wpm)</td>
<td>16 watts per meter (wpm)</td>
</tr>
<tr>
<td>80 or less</td>
<td>16 wpm</td>
<td>26 wpm</td>
</tr>
<tr>
<td>100</td>
<td>16 wpm</td>
<td>26 wpm</td>
</tr>
<tr>
<td>150</td>
<td>26 wpm</td>
<td>26 wpm</td>
</tr>
<tr>
<td>200</td>
<td>2 strips/16 wpm</td>
<td>2 strips/26 wpm</td>
</tr>
<tr>
<td>300 to 356</td>
<td>2 strips/26 wpm</td>
<td>2 strips/26 wpm</td>
</tr>
</tbody>
</table>

Control systems by an ambient sensing thermostat set at 4 degrees C either directly or through an appropriate contactor.

2.2 PIPE AND FITTINGS

Submit equipment and performance data for pipe and fittings consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.
2.2.1 Type BCS, Black Carbon Steel

Ensure pipe DN6 through DN300 is Schedule 40 black carbon steel, conforming to JIS G 3454.

Ensure pipe DN6 through DN250 is Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to JIS G 3454.

Ensure pipe DN300 through DN610 is 9.52 millimeter wall seamless black carbon steel, conforming to JIS G 3454.

Ensure fittings DN50 and under are 1034 kilopascal working steam pressure (wsp) banded black malleable iron screwed, conforming to JIS G 3454 and JIS B 2301.

Ensure unions DN50 and under are 1724 kilopascal female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to JIS B 2301.

Ensure fittings DN65 and over are Steel butt weld, conforming to JIS B 2312 to match pipe wall thickness.

Ensure flanges DN65 and over are 1034 kilopascal forged-steel conforming to JIS B 2220, welding neck to match pipe wall thickness.

2.2.2 Type BCS-125, 862 kilopascal Service

Ensure pipe DN6 through DN40 is Schedule 40 steam, Schedule 80 condensate, furnace butt weld, black carbon steel, conforming to JIS G 3456.

Ensure pipe DN50 through DN250 is Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to [Grade B (electric-resistance welded)] or [Type S (seamless)] and JIS G 3456.

Ensure pipe DN300 through DN610 is 9.52 millimeter wall, [seamless] or [electric-resistance] welded black carbon steel, conforming to JIS G 3454.

Ensure fittings DN50 and under are 862 kilopascal wsp, cast iron, screwed end, conforming to JIS G 5501 and JIS G 3454 and JIS B 2301.

Ensure fittings DN50 and under are 1034 kilopascal wsp banded black malleable iron screwed, conforming to JIS G 3455 and JIS B 2301.

Ensure fittings DN25 through DN50 are 14 or 21 megapascal water, oil, or gas (wog) to match pipe wall, forged carbon steel socket weld, conforming to JIS G 3455 and JIS B 2301.

Ensure fittings DN50 and under are 862 kilopascal wsp, cast iron, screwed end, conforming to JIS G 3454 and JIS B 2301.

Ensure fittings DN65 and over are wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to JIS G 4051 and JIS B 2311.

Ensure couplings DN50 and under are commercial standard weight for Schedule 40 pipe and commercial extra heavy weight for Schedule 80 pipe, black carbon steel where threaded, and 14 or 21 megapascal wog forged carbon steel, conforming to JIS G 3455 and JIS B 2301, where welded.
Ensure flanges DN65 and over are 1035 kilopascal, forged carbon-steel welding neck, with raised face or flat face and concentric serrated finish, conforming to JIS G 3455 and JIS B 2301.

Conform grooved pipe couplings and fittings in accordance with paragraph GROOVED PIPE COUPLINGS AND FITTINGS.

2.2.3 Type CPR, Copper

2.2.3.1 Type CPR-A, Copper Above Ground

Ensure tubing DN50 and under is seamless copper tubing, conforming to JIS H 3300, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Ensure fittings DN50 and under are 1034 kilopascal wsp wrought-copper solder joint fittings conforming to JIS H 3401.

Ensure unions DN50 and under are 1034 kilopascal wsp wrought-copper solder joint, conforming to JIS H 3401.

2.3 PIPING SPECIALTIES

Submit equipment and performance data for piping specialties consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.3.1 Air Separator

Air separated from converter discharge water is ejected by a reduced-velocity device vented to the compression tank.

Provide a commercially constructed separator, designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Provide shop drawings detailing all piping connections proposed for this work.

Ensure the air separator is carbon steel, designed, fabricated, tested, and stamped in conformance with JIS B 8267 for service pressures not less than 862 kilopascal.

2.3.2 Air Vents

Provide manual air vents using 10 millimeter globe valves.

Provide automatic air vents on pumps, mains, and where indicated using ball-float construction. Ensure the vent inlet is not less than DN20 and the outlet not less than 8 millimeter. Orifice size is 3 millimeter. Provide corrosion-resistant steel trim conforming to [JIS G 4303 ]JIS G 4305. Fit vent with try-cock. Ensure vent discharges air at any pressure up to 1034 kilopascal. Ensure outlet is copper tube routed.
2.3.3 Dielectric Connections

Electrically insulate dissimilar pipe metals from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.3.4 Expansion Vibration Isolation Joints

Construct single or multiple arch-flanged expansion vibration isolation joints of steel-ring reinforced chloroprene-impregnated cloth materials. Design joint to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Back flanges with ferrous-metal backing rings. Provide control rod assemblies to restrict joint movement. Coat all nonmetallic exterior surfaces of the joint with chlorosulphinated polyethylene. Provide grommets in limit bolt hole to absorb noise transmitted through the bolts.

Ensure joints are suitable for continuous-duty working temperature of at least 121 degrees C.

Fill arches with soft chloroprene.

Ensure joint, single-arch, movement limitations and size-related, pressure characteristics conform to MLIT-M.

2.3.5 Flexible Pipe

Construct flexible pipe vibration and pipe-noise eliminators of wire-reinforced, rubber-impregnated cloth and cord materials and be flanged. Back the flanges with ferrous-metal backing rings. Ensure service pressure-rating is a minimum 1.5 times actual service, with surge pressure at 82 degrees C.

Construct flexible pipe vibration and pipe noise eliminators of wire-reinforced chloroprene-impregnated cloth and cord materials. Ensure the pipe is flanged. Provide all flanges backed with ferrous-metal backing rings. Coat nonmetallic exterior surfaces of the flexible pipe with an acid- and oxidation-resistant chlorosulphinated polyethylene. Rate the flexible pipe for continuous duty at 896 kilopascal and 121 degrees C.

Ensure unit pipe lengths, face-to-face, are not less than the following:

<table>
<thead>
<tr>
<th>INSIDE DIAMETER (DN)</th>
<th>UNIT PIPE LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>To 65, inclusive</td>
<td>305 millimeter</td>
</tr>
<tr>
<td>80 to 100, inclusive</td>
<td>450 millimeter</td>
</tr>
<tr>
<td>125 to 300, inclusive</td>
<td>600 millimeter</td>
</tr>
<tr>
<td>To 80, inclusive</td>
<td>450 millimeter</td>
</tr>
<tr>
<td>110 to 250, inclusive</td>
<td>600 millimeter</td>
</tr>
<tr>
<td>300 and larger</td>
<td>914 millimeter</td>
</tr>
</tbody>
</table>

2.3.6 Flexible Metallic Pipe

Ensure flexible pipe is the bellows-type with wire braid cover and
designed, constructed, and rated in accordance with the applicable requirements of MLIT-M.

Minimum working pressure rating is [345] [690] kilopascal at 149 degrees C.

Ensure minimum burst pressure is four times working pressure at 149 degrees C. Bellows material is JIS G 3459 corrosion-resistant steel. Ensure braid is JIS G 4053 corrosion-resistant steel wire.

Ensure welded end connections are Schedule 80 carbon steel pipe, conforming to JIS G 3456.

Provide threaded end connections; hex-collared Schedule 40, JIS G 3459 corrosion-resistant steel, conforming to JIS G 3459.

Ensure flanged end connection rating and materials conform to specifications for system primary-pressure rating.

2.3.7 Flexible Metal Steam Hose

Provide a bellows type hose with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of MLIT-M.

Ensure the working steam pressure rating is 862 kilopascal at 260 degrees C.

Ensure minimum burst pressure is nine times working steam pressure at 149 degrees C.

Ensure bellows material is JIS G 3459 corrosion-resistant steel. Braid is JIS G 4053 corrosion-resistant steel wire.

Provide welded end connections; Schedule 80 carbon steel pressure tube, conforming to JIS G 3456.

Provide threaded end connections; hex-collared Schedule 40, JIS G 3459 corrosion-resistant steel, conforming to JIS G 3459.

Ensure flanged end connection rating and materials conform to specifications for system primary-pressure rating.

2.3.8 Metallic Expansion Joints

Provide metallic-bellows expansion joints conforming to MLIT-M.

2.3.9 Hose Faucets

Construct hose faucets with 15 millimeter male inlet threads, hexagon shoulder, and 20 millimeter hose connection, conforming to MLIT-M. Ensure hose-coupling screw threads conform to JIS B 0209-1.

Provide vandal proof, atmospheric-type vacuum breaker on the discharge of all potable water lines.

2.3.10 Pressure Gages

Ensure pressure gages conform to JIS B 7505-1 and to requirements specified herein. Pressure-gage size is 90 millimeter nominal diameter. Ensure case is corrosion-resistant steel, conforming to any of JIS G 4053 series of
JIS G 3138. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Align service-pressure reading at midpoint of gage range.

Fit steam gages with black steel syphons and steam service pressure-rated gage cocks or valves.

2.3.11 Sight-Flow Indicators

Construct sight-flow indicators for pressure service on 80 millimeter and smaller of bronze with specially treated single- or double-glass sight windows and have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on SUS 304, or SUS 316 corrosion-resistant steel shaft. Body may have screwed or flanged end. Provide pressure- and temperature-rated assembly for the applied service. Flapper flow-type indicators are not acceptable.

2.3.12 Sleeve Couplings

Sleeve couplings for plain-end pipe consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.3.13 Thermometers

Ensure thermometers conform to JIS B 7410, except for being filled with a red organic liquid. Provide an industrial pattern armored glass thermometer, (well-threaded and seal-welded). Ensure thermometers installed 1800 millimeter or higher above the floor have an adjustable angle body. Ensure scale is not less than 180 millimeter long and the case face is manufactured from manufacturer's standard polished aluminum JIS G 4053 series polished corrosion-resistant steel. Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.3.14 Pump Suction Strainers

Provide a cast iron strainer body, rated for not less than 172 kilopascal at 38 degrees C, with flanges conforming to JIS B 2239. Strainer construction is such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Ensure minimum ratio of open area of each basket to pipe area is 3 to 1. Provide a basket with JIS G 4053 series corrosion-resistant steel wire mesh with perforated backing.

Ensure mesh is capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 5 kilopascal when the basket is two-thirds dirty at maximum system flow rate. Provide reducing fittings from strainer-flange size to pipe size.

Provide a [differential-pressure gage] fitted with a two-way brass cock across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.3.15 Line Strainers, Water Service

Install Y-type strainers with removable basket. Ensure strainers in sizes
DN50 and smaller have screwed ends; in sizes DN65 and larger, strainers have flanged ends. Ensure body working-pressure rating exceeds maximum service pressure of installed system by at least 50 percent. Ensure body has cast-in arrows to indicate direction of flow. Ensure all strainer bodies fitted with screwed screen retainers have straight threads and gasketed with nonferrous metal. For strainer bodies DN65 and larger, fitted with bolted-on screen retainers, provide offset blowdown holes. Fit all strainers larger than DN65 with manufacturer’s standard ball-type blowdown valve. Ensure body material is [cast bronze conforming to MLIT-M] [cast iron conforming to Class 30]. Where system material is nonferrous, use nonferrous metal for the metal strainer body material.

Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 1.14 millimeter. Ensure strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is [SUS 304, or SUS 316 corrosion-resistant steel] [Monel metal].

2.3.16 Line Strainers, Steam Service

Install Type Y strainers with removable strainer element.

Use flanged body end connections for all valves larger than DN50, unless butt weld ends are specified. Use [screwed] [socket] weld for sizes DN50 and under to suit specified piping system end connection and maintenance requirements [or be welded].

For strainers located in tunnels, trenches, manholes, and valve pits, use welded end connections.

Body working steam pressure rating is the same as the primary valve rating for system in which strainer is installed, except where welded end materials requirements result in higher pressure ratings. Ensure body has integral cast or forged arrows to indicate direction of flow. Provide strainer bodies with blowdown valves that have discharge end plugged with a solid metal plug. Make closure assembly with tetrafluoroethylene tape. Ensure bodies fitted with bolted-on screen retainers have offset blowdown holes.

Body materials are [cast steel conforming to JIS G 5151, Grade WCB] [forged carbon steel conforming to JIS G 3202 or JIS G 3201] [manufacturer’s standard metallurgical equivalents for service pressures of 1035 kilopascal wsp and greater, and for lower pressure ratings where welding is required] [cast iron conforming to JIS B 2031, Class B, for service pressures 862 kilopascal wsp and less].

Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.51 millimeter or equivalent wire mesh. Strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is SUS 304, or SUS 316 corrosion-resistant steel and fitted with backup screens where necessary to prevent collapse.

2.4 VALVES

Submit equipment and performance data for valves consisting of corrosion resistance and life expectancy. Submit design analysis and calculations.
consisting of rates of flow, head losses, inlet and outlet design, and pressure calculations. Also include in data, pipe dimensions, as well as temperature ratings, vibration and thrust limitations, minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.4.1 Ball and Butterfly Valves

Ensure ball valves conform to JIS B 2061. For valve bodies in sizes DN50 and smaller, use screwed-end connection-type constructed of copper alloy. For valve bodies in sizes DN50 DN65 and larger, use flanged-end connection type, constructed of material. Balls and stems of valves DN50 and smaller are manufacturer's standard with hard chrome plating finish. Balls and stems of valves DN65 and larger are manufacturer's standard corrosion-resistant steel alloy with hard chrome plating. Balls of valves DN150 and larger may be Brinell hard chrome plating. Ensure valves are suitable for flow from either direction and seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Ensure all valves have adjustable packing glands. Seats and seals are fabricated from tetrafluoroethylene.

Ensure butterfly valves conform to JIS B 2032 and are the wafer type for mounting between specified flanges. Ensure valves are rated for 1034 kilopascal shutoff and nonshock working pressure. Select bodies of cast ferrous metal conforming to JIS B 2239 for body wall thickness. Seats and seals are fabricated from resilient elastomer designed for field removal and replacement.

2.4.2 Drain, Vent, and Gage Cocks

Provide [T-head] [lever handle] drain, vent, and gage cocks, ground key type, with washer and screw, constructed of polished JIS B 2240 and rated 862 kilopascal wsp. Ensure end connections are rated for specified service pressure.

Ensure pump vent cocks, and where spray control is required, constructed of manufacturer's standard polished brass. Ensure cocks are 15 millimeter male, end threaded, and rated at not less than 862 kilopascal at 107 degrees C.

2.4.3 Gate Valves (GAV)

Ensure gate valves DN50 and smaller conform to JIS B 2011. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated use union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Use rising stem type valves.

Ensure gate valves DN65 and larger, are Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (862 kilopascal steam-working pressure at 178 degrees C saturation); and 1379 kilopascal, wog (nonshock), conforming to JIS B 2031 and to requirements specified herein. Select flanged valves, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.4.4 Globe and Angle Valves (GLV-ANV)

Ensure globe and angle valves DN50 and smaller, are 862 kilopascal conforming to JIS B 2011 and to requirements specified herein. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated, use union-ring bonnet, screwed-end type. Ensure disc is free to
swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Ensure disk and packing are suitable for pipe service installed.

Ensure globe and angle valves, DN65 and larger, are cast iron with bronze trim. Ensure valve bodies are cast iron conforming to JIS B 2011. Select flanged valves in conformance with JIS B 2239. Valve construction is outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.4.5 Standard Check Valves (SCV)

Ensure standard check valves in sizes DN50 and smaller are 862 kilopascal swing check valves except as otherwise specified. Provide lift checks where indicated. Ensure swing-check pins are nonferrous and suitably hard for the service. Select composition type discs. Ensure the swing-check angle of closure is manufacturer's standard unless a specific angle is needed.

Use cast iron, bronze trim, swing type check valves in sizes DN65 and larger. Ensure valve bodies are cast iron, conforming to JIS B 2031 and valve ends are flanged in conformance with JIS B 2239. Swing-check pin is approved equal corrosion-resistant steel. Angle of closure is manufacturer's standard unless a specific angle is needed. Ensure valves have bolted and gasketed covers.

2.4.6 Nonslam Check Valves (NSV)

Provide check valves at pump discharges in sizes DN50 and larger with nonslam or silent-check operation conforming to JIS B 2031. Select a valve disc or plate that closes before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Ensure valve is Class 125 rated for 1379 kilopascal maximum, nonshock pressure at 66 degrees C in sizes to DN300. Use valves that are [wafer type to fit between flanges conforming to JIS B 2239]. Valve body may be cast iron, or equivalent strength ductile iron. Select disks using manufacturer's standard bronze, aluminum bronze, or corrosion-resistant steel. Ensure pins, springs, and miscellaneous trim are manufacturer's standard corrosion-resistant steel.

2.5 MISCELLANEOUS MATERIALS

Submit equipment and performance data for miscellaneous materials consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.5.1 Bituminous Coating

Ensure the bituminous coating is a solvent cutback, heavy-bodied material to produce not less than a 0.30 millimeter dry-film thickness in one coat, and is recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, use bituminous coating solvent cutback coal-tar type.

2.5.2 Bolting

Ensure flange and general purpose bolting is hex-head and conforms to
JIS G 4107, above (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts conform to JIS B 1181. Square-head bolts and nuts are not acceptable. Ensure threads are coarse-thread series.

2.5.3 Elastomer Caulk

Use two-component polysulfide- or polyurethane-base elastomer caulking material, conforming to JIS K 7311.

2.5.4 Escutcheons

Manufacture escutcheons from nonferrous metals and chrome-plated except when JIS G 4053 series corrosion-resistant steel is provided. Ensure metals and finish conforms to Japanese standard.

Use one-piece escutcheons where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Ensure all escutcheons have provisions consisting of internal spring-tension devices or setscrews for maintaining a fixed position against a surface.

2.5.5 Flashing

Ensure sheetlead conforms to Japanese standard

Ensure sheet copper conforms to JIS H 3100 and be not less than 4.88 kilogram per square meter weight.

2.5.6 Flange Gaskets

Provide compressed non-asbestos sheets, conforming to JIS F 0602, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 399 degrees C.

2.5.7 Grout

Provide shrink-resistant grout as a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to JIS A 0203.

Ensure shrink-resistant grout is a combination of pre-measured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength</td>
<td>13.100 Megapascal, minimum</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>96.527 Megapascal, minimum</td>
</tr>
<tr>
<td>Shrinkage, linear</td>
<td>0.003 mm per millimeter, maximum</td>
</tr>
<tr>
<td>Water absorption</td>
<td>0.1 percent, maximum</td>
</tr>
<tr>
<td>Bond strength to steel</td>
<td>6.895 Megapascal, minimum</td>
</tr>
</tbody>
</table>

2.5.8 Pipe Thread Compounds

Use polytetrafluoroethylene tape not less than 0.05 to 0.08 millimeter
thick in potable and process water and in chemical systems for pipe sizes to and including DN25. Use polytetrafluoroethylene dispersions and other suitable compounds for all other applications upon approval by the Contracting Officer; however, do not use lead-containing compounds in potable water systems.

2.6 SUPPORTING ELEMENTS

Submit equipment and performance data for the supporting elements consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Ensure supporting elements are suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Ensure supporting elements conform to requirements of MLIT-M, except as noted.

Ensure attachments welded to pipe are made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Ensure supporting elements exposed to weather are hot-dip galvanized or stainless steel. Select materials of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Electroplate supporting elements in contact with copper tubing with copper.

Ensure masonry anchor group-, type-, and style-combination designations are in accordance with JIS A 5758 and JIS B 1112. Provide support elements, except for supplementary steel, that are cataloged, load rated, commercially manufactured products.

2.6.1 Building Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Ensure anchor devices conform to JIS A 5758 and JIS B 1220.

For cast-in, floor mounted, equipment anchor devices, provide adjustable positions.

2.6.1.2 Beam Clamps

Ensure beam clamps are center-loading conforming to MLIT-M.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, conforming to MLIT-M may be used for piping sizes DN50 and less and for piping sizes DN50 through DN250 provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, determine rod diameter in accordance with referenced standards.
2.6.1.3 C-Clamps

Do not use C-clamps.

2.6.1.4 Inserts, Concrete

Use concrete conforming to MLIT-M inserts. When applied to piping in sizes DN50 and larger and where otherwise required by imposed loads, insert and wire a 305 millimeter length of 13 millimeter reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 Single Pipes

Support piping in sizes to and including DN50 by conforming to MLIT-M solid malleable iron pipe rings, except that, use split-band-type rings in sizes up to DN25.

Support piping in sizes through DN200 inclusive by conforming to MLIT-M.

Use MLIT-M assemblies on vapor-sealed insulated piping and have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system DN100 and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 13 millimeter, use conforming to MLIT-M.

Support piping in sizes larger than DN200 with conforming to MLIT-M.

Use conforming to MLIT-M shields on all insulated piping. Ensure area of the supporting surface is such that compression deformation of insulated surfaces does not occur. Roll away longitudinal and transverse shield edges from the insulation.

Provide insulated piping without vapor barrier on roll supports with conforming to MLIT-M saddles.

Provide spring supports as indicated.

2.6.2.2 Parallel Pipes

Use trapeze hangers fabricated from structural steel shapes, with U-bolts, in congested areas and where multiple pipe runs occur. Ensure structural steel shapes [conform to supplementary steel requirements] [be of commercially available, proprietary design, rolled steel].

2.6.3 Vertical Pipe Attachments

Ensure vertical pipe attachments are conforming to MLIT-M.

Include complete fabrication and attachment details of any spring supports in shop drawings.

2.6.4 Hanger Rods and Fixtures

Use only circular cross section rod hangers to connect building structure
attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers only where approved by the Contracting Officer.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.6.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with MLIT-M.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Provide certificates verifying Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Fabricate and install piping systems in accordance with JIS HB 40-1 and JIS HB 40-2.

Ensure connections between steel piping and copper piping are electrically isolated from each other with [dielectric couplings (or unions)] [flanged with gaskets] rated for the service.

Make final connections to equipment with [unions] [flanges] provided every 30480 millimeter of straight run. Provide unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Make screwed joints with specified joint compound with not more than three threads showing after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction. Do not subject the system to mechanical, chemical, vibrational or other damage as specified in MLIT-M.

Ensure field welded joints conform to the requirements of the JIS HB 40-1 and JIS HB 40-2 and JIS B 8285.

[Accomplish preheat and postheat treatment of welds in accordance with JIS B 8285.]

[Take all necessary precautions during installation of flexible pipe and]
hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Ensure installation conforms to manufacturer's instructions.

3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Provide riser and downcomer drains above piping shutoff valves in piping DN65 and larger. Tap and fit shutoff valve body with a DN15 plugged globe valve.

Provide valves unavoidably located in furred or other normally inaccessible places with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. Do not support piping from roof deck or from other pipe.

Run piping parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there is no less than DN15 of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Arrange hangars on different adjacent service lines running parallel with each other in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 900 millimeter from the ends of each runout, and not over 300 millimeter from each change in direction of piping.

Base load rating for all pipe-hanger supports on insulated weight of lines filled with water and forces imposed. Deflection per span is not exceed slope gradient of pipe. Ensure supports are in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, reduce the allowable span proportionately:

<table>
<thead>
<tr>
<th>PIPE SIZE (DN) MILLIMETER</th>
<th>ROD SIZE MILLIMETER</th>
<th>STEEL PIPE MILLIMETER</th>
<th>COPPER PIPE MILLIMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 and smaller</td>
<td>10</td>
<td>2500</td>
<td>1850</td>
</tr>
<tr>
<td>32 to 40</td>
<td>10</td>
<td>3050</td>
<td>2500</td>
</tr>
<tr>
<td>50</td>
<td>10</td>
<td>3050</td>
<td>3050</td>
</tr>
<tr>
<td>65 to 90</td>
<td>13</td>
<td>3700</td>
<td>3700</td>
</tr>
<tr>
<td>100 to 125</td>
<td>16</td>
<td>5000</td>
<td>4300</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>PIPE SIZE (DN) MILLIMETER</th>
<th>ROD SIZE MILLIMETER</th>
<th>STEEL PIPE MILLIMETER</th>
<th>COPPER PIPE MILLIMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>20</td>
<td>5000</td>
<td>5000</td>
</tr>
<tr>
<td>200 to 300</td>
<td>22</td>
<td>6100</td>
<td>6100</td>
</tr>
<tr>
<td>356 to 457</td>
<td>25</td>
<td>6100</td>
<td>6100</td>
</tr>
<tr>
<td>508 and over</td>
<td>32</td>
<td>6100</td>
<td>6100</td>
</tr>
</tbody>
</table>

Provide vibration isolation supports where needed. Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT where A/C equipment and piping is installed.

Support vertical risers independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Ensure risers have guides for lateral stability. For risers subject to expansion, provide only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 4572 millimeter intervals for pipe DN50 and smaller and at not more than 6096 millimeter intervals for pipe DN65 and larger.

3.4 PENETRATIONS

Provide effective sound stopping and adequate operating clearance to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceilings where no special acoustic treatment of ceiling is provided. Finish penetrations to be compatible with surface being penetrated.

[Accomplish sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 49 degrees C, by foaming-in-place with self-extinguishing, 0.9 kilogram density polyurethane foam to a depth not less than 152 millimeter. Finish foam with a rasp. Ensure vapor barrier is not less than 3 millimeter thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, use only mineral wool with openings covered by 1.6 millimeter sheet metal.]

3.5 SLEEVES

Provide sleeves where piping passes through roofs, masonry, concrete walls and floors.

Continuously [weld] [braze] sleeves passing through steel decks to the deck.

Ensure sleeves that extend through floors, roofs, load bearing walls, and fire barriers are continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. Form all other sleeves by molded linear polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and
jacketing without touching the sleeve and provides a minimum 10 millimeter clearance. Install a sleeve size to accommodate mechanical and thermal motion of pipe precluding transmission of vibration to walls and the generation of noise.

Pack the space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration solid with a mineral fiber conforming to JIS A 9504. Provide this packing wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration with an elastomer caulk to a depth of 13 millimeter. Ensure all caulked surfaces are oil- and grease-free.

Ensure through-penetration fire stop materials and methods are in accordance with ISO 834-1.

Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

Ensure sleeve height above roof surface is a minimum of 305 and a maximum of 457 millimeter.

3.6 ESCUTCHEONS

Provide escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide plates at the underside only of such ceilings. For insulated pipes, select plates large enough to fit around the insulation. Use chrome-plated escutcheons in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

3.7 FLASHINGS

[ Provide flashings at penetrations of building boundaries by mechanical systems and related work.

]3.8 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, clean all piping, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Further inspect suspect cast-ferrous piping by painting with kerosene on external surfaces to reveal cracks.

Distinctly mark defective materials found using a road-traffic quality yellow paint; promptly remove defective material from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, coat all external surfaces of cast ferrous conduit with a compatible bituminous coating for protection against brackish ground water. Apply a single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 0.30
millimeter.

Ensure excavations are dry and clear of extraneous materials when pipe is being laid.

Use wheel cutters for cutting of piping or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting is not permitted.

Begin laying of pipe at the low point of a system. When in final acceptance position, ensure it is true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging is not permitted.

[Point bell or grooved ends of piping upstream.]

Make changes in direction with long sweep fittings.

Provide necessary socket clamping, piers, bases, anchors, and thrust blocking. Protect rods, clamps, and bolting with a coating of bitumen.

Support underground piping below supported or suspended slabs from the slab with a minimum of two supports per length of pipe. Protect supports with a coating of bitumen.

On excavations that occur near and below building footings, provide backfilling material consisting of 13800 kilopascal cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Properly support vertical downspouts; soil, waste, and vent stacks; water risers; and similar work on approved piers at the base and provided with approved structural supports attached to building construction.

[Provide cleanout, flushing, and observation risers.]

3.9 HEAT TRACE CABLE INSTALLATION

Field apply heater tape and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Contracting Officer. Secure the heater to piping with [cable ties] [fiberglass tape]. Label thermal insulation on the outside, "Electrical Heat Trace."

Install power connection, end seals, splice kits and tee kit components provide a complete workable system. Terminate connection to the thermostat and ends of the heat tape in a junction box. Ensure cable and conduit connections are raintight.

3.10 DISINFECTION

[Disinfect water piping, including all valves, fittings, and other devices, with a solution of chlorine and water. Ensure the solution contains not less than 50 parts per million (ppm) of available chlorine. Hold solution for a period of not less than 8 hours, after which the solution contains not less than 10 ppm of available chlorine or redisinfect the piping. After successful sterilization, thoroughly flush the piping before placing into service. Flushing is complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfected will be furnished by]
the Government. Approve disposal of contaminated flush water in accordance with written instructions received from the Environmental authority having jurisdiction through the Contracting Officer and all local, State and Federal Regulations.

[Flush piping with potable water until visible grease, dirt and other contaminants are removed (visual inspection).]

3.11 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Submit test data that is clear and readily legible.

3.12 PAINTING OF NEW EQUIPMENT

Factory or shop apply new equipment painting, as specified herein, and provided under each individual section.

3.12.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied withstands 125 hours in a salt-spray fog test, except that equipment located outdoors withstand 500 hours in a salt-spray fog test. Conduct salt-spray fog test in accordance with Japanese Industry Standards, and for that test the acceptance criteria is as follows: immediately after completion of the test, the inspected paint shows no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shows no signs of rust creepage beyond 3 mm on either side of the scratch mark.

Ensure the film thickness of the factory painting system applied on the equipment is not less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, design the factory painting system for the temperature service.

3.12.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal, surfaces subject to temperatures in excess of 50 degrees C.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Selected color of finish coat is aluminum or light gray.

a. Temperatures Less Than 50 Degrees C: Immediately after cleaning, the metal surfaces subject to temperatures less than 50 degrees C receives one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat.

b. Temperatures Between 50 and 205 Degrees C: Metal surfaces subject to
temperatures between 50 and 205 degrees C Receives two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm.

c. Temperatures Greater Than 205 Degrees C: Metal surfaces subject to temperatures greater than 205 degrees C receives two coats of 315 degrees C heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm.

-- End of Section --
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 07 00

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02/13

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PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

ASTM INTERNATIONAL (ASTM)


ASTM C612 (2014) Mineral Fiber Block and Board Thermal Insulation


ASTM D882 (2012) Tensile Properties of Thin Plastic Sheeting


<table>
<thead>
<tr>
<th>Organization/Standard</th>
<th>Reference</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>GS-36</td>
<td>(2013)</td>
<td>Adhesives for Commercial Use</td>
</tr>
<tr>
<td>ISO 2758</td>
<td>(2014)</td>
<td>Paper - Determination of Bursting Strength</td>
</tr>
<tr>
<td>SCAQMD Rule 1168</td>
<td>(2017)</td>
<td>Adhesive and Sealant Applications</td>
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<td>TAPPI T403 OM</td>
<td>(2015)</td>
<td>Bursting Strength of Paper</td>
</tr>
<tr>
<td>MIL-PRF-19565</td>
<td>(1988; Rev C)</td>
<td>Coating Compounds, Thermal Insulation, Fire- and Water-Resistant,</td>
</tr>
</tbody>
</table>
1.2 SYSTEM DESCRIPTION

1.2.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Insulation of heat distribution systems and chilled water systems outside of buildings shall be as specified in Section 33 61 13 PRE-ENGINEERED UNDERGROUND HEAT DISTRIBUTION SYSTEM, Section 33 63 13.19 CONCRETE TRENCH HYDRONIC AND STEAM ENERGY DISTRIBUTION, Section 33 60 02 ABOVEGROUND HEAT DISTRIBUTION SYSTEM, and Section 33 61 13.13 PREFABRICATED UNDERGROUND HYDRONIC ENERGY DISTRIBUTION. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings
Pipe Insulation Systems and Associated Accessories
Duct Insulation Systems and Associated Accessories
Equipment Insulation Systems and Associated Accessories

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by JIS A 5538.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet.

2.1.1 Insulation System

Provide insulation systems in accordance with MLIT-M. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems.
2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation must have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

2.2 MATERIALS

Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state.

2.2.1 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to JIS A 5538.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with JIS A 9504.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented [white] [red] and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and
a maximum smoke developed index of 50 when tested in accordance with
ASTM E84. The adhesive shall not adversely affect, initially or in
service, the insulation to which it is applied, nor shall it cause any
corrosive effect on metal to which it is applied. Any solvent dispersing
medium or volatile component of the adhesive shall have no objectionable
odor and shall not contain any benzene or carbon tetrachloride. The dried
adhesive shall not emit nauseous, irritating, or toxic volatile matters or
aerosols when the adhesive is heated to any temperature up to 100 degrees C.
The dried adhesive shall be nonflammable and fire resistant. Flexible
Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide
product listed in FM APP GUIDE.

2.2.2 Caulking

Caulking shall be in accordance with MLIT-M.

2.2.3 Corner Angles

Nominal 0.406 mm aluminum 25 by 25 mm with factory applied kraft backing.
Aluminum shall be JIS H 4000.

2.2.4 Finishing Cement

MLIT-M: Mineral fiber hydraulic-setting thermal insulating and finishing
cement. All cements that may come in contact with Austenitic stainless
steel must comply with MLIT-M.

2.2.5 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall be
have maximum flame spread index of 25 and a maximum smoke developed index
of 50 when tested in accordance with ASTM E84. Tape shall be 100 mm wide
rolls. Class 3 tape shall be 0.15 kg/square m. Elastomeric Foam Tape:
Black vapor-retarder foam tape with acrylic adhesive containing an
anti-microbial additive.

2.2.6 Staples

Outward clinching type [monel] [JIS G 4304, Type 304 or 316 stainless
steel].

2.2.7 Jackets

2.2.7.1 Aluminum Jackets

Aluminum jackets shall be in accordance with MLIT-M, Table 2.3.1 and 2.3.2.

2.2.7.2 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be in accordance with MLIT-M,
Table 2.3.1 and 2.3.2.

2.2.8 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all
surfaces except concealed ductwork, where a minimum puncture resistance of
25 Beach units is acceptable. Minimum tensile strength, 6.1 N/mm width.
ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile
strength minimum 3.5 N/mm width. Jackets used on insulation exposed in
finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomers require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.8.1 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.8.1.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 0.05 mm adhesive, 0.075 mm embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84. Flame and smoke requirements and shall be UV resistant.

2.2.8.1.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be 0.013 perms or less at 1 mm dry film thickness as determined according to procedure B of ASTM E96/E96M or utilizing apparatus described in ASTM E96/E96M. The coating shall be nonflammable, fire resistant type. [To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating.] Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be in accordance with ASTM C647.

2.2.8.2 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.8.3 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 5.3 kN/m when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.8.4 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet
UL 723 or ASTM E84. 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 1.3 MPa in accordance with [TAPPI T403 OM] [ISO 2758]. Tensile strength 0.12 kg/m width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.9 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.10 Wire

Wire shall be in accordance with MLIT-M.

2.2.11 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.3 PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet. Limit pipe insulation materials to those listed herein and meeting the following requirements:

2.3.1 Aboveground Cold Pipeline (-34 to 16 deg. C)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

2.3.1.1 Mineral Fiber Insulation with Integral Wicking Material (MFIWM)

JIS A 9504. Install in accordance with manufacturer's instructions. Do not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

2.3.2 Aboveground Hot Pipeline (Above 16 deg. C)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.2.1 Mineral Fiber

JIS A 9504, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3 Aboveground Dual Temperature Pipeline

Selection of insulation for use over a dual temperature pipeline system (Outdoor, Indoor - Exposed or Concealed) shall be in accordance with the most limiting/restrictive case. Find an allowable material from paragraph PIPE INSULATION MATERIALS and determine the required thickness from the
most restrictive case. Use the thickness listed in paragraphs INSULATION THICKNESS for cold & hot pipe applications.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

Provide factory-applied insulation for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier[, with identification of installed thermal resistance (R) value and out-of-package R value].

2.4.2 Kitchen Exhaust Ductwork Insulation

Insulation thickness shall be a minimum of 50 mm, blocks or boards, either mineral fiber conforming to JIS A 9504. The enclosure materials and the grease duct enclosure systems shall meet testing requirements for noncombustibility, fire resistance, durability, internal fire, and fire-engulfment with a through-penetration fire stop.

2.4.3 Acoustical Duct Lining

2.4.3.1 General

For ductwork indicated or specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM to be acoustically lined, provide external insulation in accordance with this specification section and in addition to the acoustical duct lining. Do not use acoustical lining in place of duct wrap or rigid board insulation (insulation on the exterior of the duct).

2.4.4 Duct Insulation Jackets

2.4.4.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.4.2 Metal Jackets

2.4.4.2.1 Aluminum Jackets

JIS H 4000, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 200 mm and larger. Provide corrugated surface jackets for jacket outside dimension 200 mm and larger. Provide stainless steel bands, minimum width of 13 mm.

2.4.4.2.2 Stainless Steel Jackets

JIS G 4304; Type 304, smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 13 mm.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in accordance with MLIT-M,
PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Display Samples

Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

3.1.1.1 Pipe Insulation Display Sections

Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

3.1.1.2 Duct Insulation Display Sections

Display sample sections for rigid and flexible duct insulation used on the job. Use a temporary covering to enclose and protect display sections for duct insulation exposed to weather.

3.1.2 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until [tests] [tests and heat tracing] specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral
fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with plates except where modified herein or on the drawings.

3.1.3 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by MLIT-M.

3.1.4 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.
f. Access plates of fan housings.
g. Cleanouts or handholes.

3.2.1.2 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1.

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Specification</th>
<th>Type</th>
<th>Class</th>
<th>VR/VB Req'd</th>
</tr>
</thead>
</table>
| Chilled Water (Supply & Return, Dual Temperature Piping, 4.44 C nominal)| [Mineral Fiber with Wicking Material][Do not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.]
|                                                                        | [] JIS A 9504                           | [I]            | [Yes]|
| Heating Hot Water Supply & Return, Heated Oil (Max 121 C)              | Mineral Fiber                           | JIS A 9504     |      |
| Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping| Mineral Fiber                           | JIS A 9504     |      |
| Hot Domestic Water Supply & Recirculating Piping (Max 93 C)             | Mineral Fiber                           | JIS A 9504     |      |
| Refrigerant Suction Piping (1.67 degrees C nominal)                     | Shall be pre-insulated by manufacturer |                |      |
| Compressed Air Discharge, Steam and Condensate Return (94 to 121 Degrees C) | Mineral Fiber                           | JIS A 9504     |      |
| Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel | Mineral Fiber                           | JIS A 9504     |      |
| Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings) | Mineral Fiber                           | JIS A 9504     |      |
| Condensate Drain Located Inside Building                                | Mineral Fiber                           | JIS A 9504     |      |
| Medium Temperature Hot Water, Steam and Condensate (122 to 176 Degrees C) | Mineral Fiber                           | JIS A 9504     |      |
### TABLE 1
**Insulation Material for Piping**

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Specification</th>
<th>Type</th>
<th>Class</th>
<th>VR/VB Req'd</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Temperature Hot Water &amp; Steam (177 to 371 Degrees C)</td>
<td>Mineral Fiber</td>
<td>JIS A 9504</td>
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<tr>
<td>Brine Systems Cryogenics (-34 to -18 Degrees C)</td>
<td>Mineral Fiber</td>
<td>JIS A 9504</td>
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<tr>
<td>Brine Systems Cryogenics (-18 to 1.11 Degrees C)</td>
<td>Mineral Fiber</td>
<td>JIS A 9504</td>
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</table>

*Note: VR/VB = Vapor Retarder/Vapor Barrier*

### TABLE 2
**Piping Insulation Thickness (mm)**

For flexible cellular foam the thickness should be 13mm instead of 15mm. Economic thickness or prevention of condensation is the basis of these tables. If prevention of condensation is the criterion, the ambient temperature and relative humidity must be stated. Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Tube And Pipe Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Chilled Water (Supply &amp; Return, Dual Temperature Piping, 4.44 Degrees C nominal)]</td>
<td>Mineral Fiber with Wicking Material</td>
<td>&lt;25  25<del>40  40</del>&lt;100  100~&lt;200  &gt; or = 200</td>
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<tr>
<td>[Chilled Water (Supply &amp; Return, Dual Temperature Piping, 4.44 Degrees C nominal)]</td>
<td>Mineral Fiber with Wicking Material</td>
<td>25  40  40  50  50</td>
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<tr>
<td>Heating Hot Water Supply &amp; Return, Heated Oil (Max 121 C)</td>
<td>Mineral Fiber</td>
<td>40  40  50  50  50</td>
</tr>
</tbody>
</table>
TABLE 2

Piping Insulation Thickness (mm)
For flexible cellular foam the thickness should be 13mm instead of 15mm. Economic thickness or prevention of condensation is the basis of these tables. If prevention of condensation is the criterion, the ambient temperature and relative humidity must be stated. Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

Service

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<tr>
<th>Material</th>
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Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping

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Flexible Elastomeric Cellular

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Hot Domestic Water Supply & Recirculating Piping (Max 93 C)

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Refrigerant Suction Piping (1.67 degrees C nominal)

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Shall be pre-insulated by manufacturer

Compressed Air Discharge, Steam and Condensate Return (94 to 121 Degrees C)

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Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel

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Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)

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Condensate Drain Located Inside Building

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Medium Temperature Hot Water, Steam and Condensate (122 to 176 Degrees C)

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</tr>
<tr>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
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<td></td>
<td></td>
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<tr>
<td>100</td>
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<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>65*</th>
<th>80*</th>
<th>90*</th>
</tr>
</thead>
<tbody>
<tr>
<td>65*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE 2

Piping Insulation Thickness (mm)
For flexible cellular foam the thickness should be 13mm instead of 15mm. Economic thickness or prevention of condensation is the basis of these tables. If prevention of condensation is the criterion, the ambient temperature and relative humidity must be stated. Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

<table>
<thead>
<tr>
<th>Service</th>
<th>Material</th>
<th>Tube And Pipe Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25-&lt;40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40-&lt;100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-&lt;200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; or = 200</td>
</tr>
<tr>
<td>High Temperature Hot Water &amp; Steam (177 to 371 Degrees C)</td>
<td>Mineral Fiber</td>
<td>65</td>
</tr>
<tr>
<td>Brine Systems Cryogenics (-34 to -18 Degrees C)</td>
<td>Mineral Fiber</td>
<td>40</td>
</tr>
<tr>
<td>Brine Systems Cryogenics (-18 to 1.11 Degrees C)</td>
<td>Mineral Fiber</td>
<td>40</td>
</tr>
</tbody>
</table>

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 34 to plus 16 degrees C, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Horizontal and vertical portions of interior roof drains.

c. Refrigerant suction lines.

d. Chilled water.

e. Dual temperature water, i.e. HVAC hot/chilled water.

f. Air conditioner condensate drains.

g. Brine system cryogenics

h. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

i. Domestic cold and chilled drinking water.
3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 16 degrees C, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.
b. Steam.
c. Condensate & compressed air discharge.
d. Hot water heating.
e. Heated oil.
f. Water defrost lines in refrigerated rooms.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed in accordance with MLIT-M.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved plates as supplemented by the manufacturer's published installation instructions. Duct insulation minimum thickness and insulation level must be as listed in Table 3.

3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

<table>
<thead>
<tr>
<th>Table 4 - Minimum Duct Insulation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Air Ducts</td>
</tr>
<tr>
<td>Relief Ducts</td>
</tr>
<tr>
<td>Fresh Air Intake Ducts</td>
</tr>
<tr>
<td>Warm Air Ducts</td>
</tr>
<tr>
<td>Relief Ducts</td>
</tr>
</tbody>
</table>
3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment:

a. Supply ducts.
b. Return air ducts.
c. Relief ducts.
d. Flexible run-outs (field-insulated).
e. Plenums.
f. Duct-mounted coil casings.
g. Coil headers and return bends.
h. Coil casings.
i. Fresh air intake ducts.
j. Filter boxes.
k. Mixing boxes (field-insulated).
l. Supply fans (field-insulated).
m. Site-erected air conditioner casings.
n. Ducts exposed to weather.
o. Combustion air intake ducts.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:

a. Supply ducts.
b. Return air ducts.
c. Relief air ducts
d. Flexible run-outs (field insulated).
e. Plenums.
f. Duct-mounted coil casings.
g. Coil-headers and return bends.
h. Coil casings.
i. Fresh air intake ducts.
j. Filter boxes.
k. Mixing boxes.
l. Supply fans.
m. Site-erected air conditioner casings.
n. Ducts exposed to weather.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 16 degrees C, ducts shall be insulated as specified for cold air duct.

3.3.5 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.6 Duct Exposed to Weather

3.3.6.1 Installation

Ducts exposed to weather shall be insulated and finished as specified in accordance with MLIT-M.

3.3.7 Kitchen Exhaust Duct Insulation

NFPA 96 for [ovens,] [griddles,] [deep fat fryers,] [steam kettles,] [vegetable steamers,] [high pressure cookers,] [and] [mobile serving units]. Provide insulation with 19 mm wide, minimum 4 mm thick galvanized steel bands spaced not over 305 mm o.c.; or 16 gauge galvanized steel wire with corner clips under the wire; or with heavy welded pins spaced not over 305 mm apart each way. Do not use adhesives.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with MLIT-M.

3.4.1 Insulation for Cold Equipment

Cold equipment below 16 degrees C: Insulation shall be furnished on equipment handling media below 16 degrees C including the following:

a. Pumps.
b. Refrigeration equipment parts that are not factory insulated.
c. Drip pans under chilled equipment.
d. Cold water storage tanks.
e. Water softeners.
f. Duct mounted coils.
g. Cold and chilled water pumps.
h. Pneumatic water tanks.
i. Roof drain bodies.
j. Air handling equipment parts that are not factory insulated.
k. Expansion and air separation tanks.

3.4.1.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral Fiber MLIT-M</td>
<td></td>
</tr>
</tbody>
</table>

3.4.2 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 16 degrees C including the following:

a. Converters.
b. Heat exchangers.
c. Hot water generators.
d. Water heaters.
e. Pumps handling media above 54 degrees C.
f. Fuel oil heaters.
g. Hot water storage tanks.
h. Air separation tanks.
i. Surge tanks.
j. Flash tanks.
k. Feed-water heaters.
l. Unjacketed boilers or parts of boilers.
m. Boiler flue gas connection from boiler to stack (if inside).
n. Induced draft fans.
o. Fly ash and soot collectors.
p. Condensate receivers.

3.4.2.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table 6:

<table>
<thead>
<tr>
<th>Equipment handling steam or media at indicated pressure or temperature limit</th>
<th>Material</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>103 kPa or 121 degrees C</td>
<td>Rigid Mineral Fiber</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Flexible Mineral Fiber</td>
<td>50</td>
</tr>
<tr>
<td>1380 kPa or 204 degree C</td>
<td>Rigid Mineral Fiber</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Flexible Mineral Fiber</td>
<td>75</td>
</tr>
<tr>
<td>316 degrees C</td>
<td>Rigid Mineral Fiber</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>Flexible Mineral Fiber</td>
<td>150</td>
</tr>
</tbody>
</table>

316 degrees C: Thickness necessary to limit the external temperature of the insulation to 50 C. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

3.4.2.2 Insulation of Boiler Stack and Diesel Engine Exhaust Pipe

Insulation type and thickness shall be in accordance with the following Table 7.
TABLE 7

Insulation and Thickness for Boiler Stack and Diesel Engine Exhaust Pipe

Service & Surface Temperature Range (Degrees C)

<table>
<thead>
<tr>
<th>Material</th>
<th>Outside Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 - 32</td>
</tr>
</tbody>
</table>

Boiler Stack (Up to 204 degrees C)

<table>
<thead>
<tr>
<th>Mineral Fiber</th>
<th>N/A</th>
<th>N/A</th>
<th>75</th>
<th>90</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS A 9504</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Boiler Stack (205 to 315 degrees C)

<table>
<thead>
<tr>
<th>Mineral Fiber</th>
<th>N/A</th>
<th>N/A</th>
<th>100</th>
<th>100</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS A 9504 ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mineral Fiber/Cellular Glass Composite:

<table>
<thead>
<tr>
<th>Mineral Fiber</th>
<th>25</th>
<th>25</th>
<th>25</th>
<th>25</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS A 9504 ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Boiler Stack (316 to 427 degrees C)

<table>
<thead>
<tr>
<th>Mineral Fiber</th>
<th>N/A</th>
<th>N/A</th>
<th>100</th>
<th>100</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS A 9504 ASTM C547 Class 3, ASTM C592 Class 1, or ASTM C612 Class 3 JIS A 9504</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Mineral Fiber/Cellular Glass Composite:

<table>
<thead>
<tr>
<th>Mineral Fiber</th>
<th>50</th>
<th>50</th>
<th>50</th>
<th>80</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS A 9504 ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3 JIS A 9504</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Diesel Engine Exhaust (Up to 371 degrees C)
### TABLE 7

Insulation and Thickness for Boiler Stack and Diesel Engine Exhaust Pipe

<table>
<thead>
<tr>
<th>Service &amp; Surface Temperature Range (Degrees C)</th>
<th>Material</th>
<th>Outside Diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 - 32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 - 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90-125</td>
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<tr>
<td></td>
<td></td>
<td>150 - 250</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; or = 280 - 900</td>
</tr>
<tr>
<td>Mineral Fiber JIS A 9504 ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3 JIS A 9504</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
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<tr>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80</td>
</tr>
</tbody>
</table>

3.4.3 Equipment Handling Dual Temperature Media

Below and above 16 degrees C: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.4 Equipment Exposed to Weather

3.4.4.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

--- End of Section ---
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    1.3.2 Contract Drawings
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    1.5.1 General
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  3.2.3.4 Flared Connections
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  3.2.4.3 Valve Identification
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3.2.6 Strainers
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3.2.10 Accumulator
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  3.2.13.1 Horizontal Pipe Supports
  3.2.13.2 Vertical Pipe Supports
  3.2.13.3 Multiple Pipe Runs
  3.2.13.4 Seismic Requirements
  3.2.13.5 Structural Attachments
3.2.14 Pipe Alignment Guides
3.2.15 Pipe Anchors
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  3.2.16.2 General Service Areas
  3.2.16.3 Waterproof Penetrations
    3.2.16.3.1 Waterproofing Clamping Flange
    3.2.16.3.2 Modular Mechanical Type Sealing Assembly
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  3.2.19.1 Color Coding
  3.2.19.2 Color Coding Scheme
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-- End of Section Table of Contents --
PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 1180  (2014) Hexagon Head Bolts and Hexagon Head Screws
JIS B 2220  (2012) Steel Pipe Flanges
JIS B 2301  (2013) Screwed Type Malleable Cast Iron Pipe Fittings
JIS B 2312  (2015) Steel Butt-Welding Pipe Fittings
JIS B 2316  (2017) Steel Socket-Welding Pipe Fittings
JIS B 8605  (2002) Stop Valves for Refrigerants
JIS G 3302  (2019) Hot Dip Zinc Coated Steel Sheet and Strip
JIS G 3454  (2019) Carbon Steel Pipes for Pressure Service (Amendment 1)
JIS H 3300  (2018) Copper and Copper Alloy Seamless Pipes and Tubes
JIS H 3401  (2001) Pipe Fittings of Copper and Copper
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIS H 8641</td>
<td>(2007) Hot Dip Galvanized Coatings</td>
</tr>
<tr>
<td>JIS K 7137-2</td>
<td>(2001) Plastics-Polytetrafluoroethylene (PTFE) Semi-Finished Products-</td>
</tr>
<tr>
<td></td>
<td>Part 2: Preparation of Test Specimens and Determination of Properties</td>
</tr>
<tr>
<td>JIS Z 3197</td>
<td>(2012) Test Methods for Soldering Fluxes</td>
</tr>
<tr>
<td>JIS Z 3202</td>
<td>(2007) Copper and Copper Alloy Gas Welding Rods</td>
</tr>
<tr>
<td></td>
<td>Welding Technique</td>
</tr>
<tr>
<td>JIS Z 3821</td>
<td>(2018) Standard Qualification Test and Acceptance Requirements for Welding</td>
</tr>
<tr>
<td></td>
<td>Technique of Stainless Steel</td>
</tr>
</tbody>
</table>

JAPAN WELDING ENGINEERING SOCIETY

JWES

Japan Welding Engineering Society

MLIT MECHANICAL STANDARD SPECIFICATION

MLIT-M


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval]. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Refrigerant Piping System; G[ , [____]]

SD-06 Test Reports

Refrigerant Piping Tests

SD-10 Operation and Maintenance Data

Maintenance

Operation and Maintenance Manuals

Demonstrations
1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Submit [_____] copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations. Piping shall be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with JIS Z 3801. Notify the Contracting Officer 24 hours in advance of tests to be performed at the work site, if practical. The welder or welding operator shall apply the personally assigned symbol near each weld made, as a permanent record. Structural members shall be welded in accordance with Section [05 12 00 STRUCTURAL STEEL]. Welding and nondestructive testing procedures are specified in Section [40 05 13.96 WELDING PROCESS PIPING].

1.3.2 Contract Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.5 MAINTENANCE

1.5.1 General

Submit Data Package 2 plus operation and maintenance data complying with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

1.5.2 Extra Materials

Submit spare parts data for each different item of equipment specified, after approval of detail drawings and not later than [_____] months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

a. Provide materials and equipment which are standard products of a manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for 2 years prior to
b. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.

c. Products shall be supported by a service organization location in Japan. System components shall be environmentally suitable for the indicated locations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

d. Exposed equipment moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with MLIT-M and JIS Z 3801.

e. Manufacturer's standard catalog data, at least [5 weeks] [_____] prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include in the data manufacturer's recommended installation instructions and procedures. Provide data for the following components as a minimum:

(1) Piping and Fittings
(2) Valves
(3) Piping Accessories
(4) Pipe Hangers, Inserts, and Supports

2.2 ELECTRICAL WORK

[Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Field wiring shall be in accordance with manufacturer's instructions.] [Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.]

2.3 REFRIGERANT PIPING SYSTEM

Refrigerant piping, valves, fittings, and accessories shall be in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese Standard., except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and
sealed (capped or plugged) prior to shipment from the manufacturer's
plant. Submit drawings, at least [5] [_____] weeks prior to beginning
construction, provided in adequate detail to demonstrate compliance with
contract requirements. Drawings shall consist of:

a. Piping layouts which identify all valves and fittings.
b. Plans and elevations which identify clearances required for maintenance
   and operation.

2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

2.4.1 Steel Pipe

Steel pipe for refrigerant service shall conform to JIS G 3454 & JIS B 2301,
Schedule 40.

2.4.1.1 Welded Fittings and Connections

Butt-welded fittings shall conform to JIS B 2312. Socket-welded fittings
shall conform to JIS B 2316. Welded fittings shall be identified with the
appropriate grade and marking symbol. Welded valves and pipe connections
(both butt-welds and socket-welds types) shall conform to JIS B 2312 or
JIS B 2316.

2.4.1.2 Threaded Fittings and Connections

Threaded fitting shall conform to JIS B 2301. Threaded valves and pipe
connections shall conform to JIS B 2301.

2.4.1.3 Flanged Fittings and Connections

Flanges shall conform to JIS B 2220. Gaskets shall be non asbestos
compressed material in accordance with JIS B 2404, 1.59 mm thickness, full
face or self-centering flat ring type. This gaskets shall contain aramid
fibers bonded with styrene butadeine rubber (SBR) or nitrile butadeine
rubber (NBR). Bolts, nuts, and bolt patterns shall conform to JIS B 2220.
Bolts shall be high or intermediate strength material conforming to
JIS B 1180.

2.4.2 Copper Tubing

Copper tubing shall conform to JIS H 3300 and JIS H 3401, annealed or hard
drawn as required. Copper tubing shall be soft annealed where bending is
required and hard drawn where no bending is required. Soft annealed copper
tubing shall not be used in sizes larger than 35 mm. Joints shall be
brazed except that joints on lines 22 mm and smaller may be flared. Cast
copper alloy fittings for flared copper tube shall conform to JIS H 3401.
Wrought copper and bronze solder-joint pressure fittings shall conform to
JIS H 3401. Joints and fittings for brazed joint shall be wrought-copper
or forged-brass sweat fittings. Cast sweat-type joints and fittings shall
not be allowed for brazed joints. Brass or bronze adapters for brazed
tubing may be used for connecting tubing to flanges and to threaded ends of
valves and equipment.

2.4.3 Solder

Solder shall conform to JIS Z 3284-1, tin-antimony alloy for service
pressures up to 1034 kPa. Solder flux shall be liquid or paste form,
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non-corrosive and conform to JIS Z 3197.

2.4.4 Brazing Filler Metal

Filler metal shall conform to JIS Z 3202.

2.5 VALVES

Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves 25 mm and smaller shall have brazed or socket welded connections. Valves larger than 25 mm shall have [tongue-and-groove flanged] [butt welded] end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

2.5.1 Refrigerant Stop Valves

Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a [handwheel] [or] [wrench] operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

2.5.2 Check Valves

Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provided with resilient seat.

2.5.3 Liquid Solenoid Valves

Valves shall comply with JIS B 8471 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 2760 kPa and a maximum operating pressure differential of at least 1375 kPa at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

2.5.4 Expansion Valves

Valve shall conform to JIS B 8619. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and...
inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 1 degree C of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicated or for constant evaporator loads.

2.5.5 Safety Relief Valves

Valve shall be the two-way type, unless indicated otherwise. Valve shall conform to JIS B 8225. Valve capacity shall be certified by the National Board of Boiler and Pressure Vessel Inspectors or Japan Boiler Association. Valve shall be of an automatically reseating design after activation.

2.5.6 Evaporator Pressure Regulators, Direct-Acting

Valve shall include a diaphragm/spring assembly, external pressure adjustment with seal cap, and pressure gauge port. Valve shall maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load shall not exceed the pressure difference corresponding to a 1 degree C change in saturated refrigerant temperature at evaporator operating suction temperature. Spring shall be selected for indicated maximum allowable suction pressure range.

2.5.7 Refrigerant Access Valves

Refrigerant access valves and hose connections shall be in accordance with JIS B 8605.

2.6 PIPING ACCESSORIES

2.6.1 Filter Driers

Sizes 15 mm and larger shall be the full flow, replaceable core type. Sizes 13 mm and smaller shall be the sealed type. Cores shall be of suitable desiccant that will not plug, cake, dust, channel, or break down, and shall remove water, acid, and foreign material from the refrigerant. Filter driers shall be constructed so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure shall be 10.3 MPa.

2.6.2 Sight Glass and Liquid Level Indicator

2.6.2.1 Assembly and Components

Assembly shall be pressure- and temperature-rated and constructed of materials suitable for the service. Glass shall be borosilicate type. Ferrous components subject to condensation shall be electro-galvanized.
2.6.2.2 Gauge Glass

Gauge glass shall include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.6.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Bull's-eye and inline sight glass reflex lens shall be provided for dead-end liquid service. For pipe line mounting, two plain lenses in one body suitable for backlit viewing shall be provided.

2.6.2.4 Moisture Indicator

Indicator shall be a self-reversible action, moisture reactive, color changing media. Indicator shall be furnished with full-color-printing tag containing color, moisture and temperature criteria. Unless otherwise indicated, the moisture indicator shall be an integral part of each corresponding sight glass.

2.6.3 Vibration Dampeners

Dampeners shall be of the all-metallic bellows and woven-wire type.

2.6.4 Flexible Pipe Connectors

Connector shall be a composite of interior corrugated phosphor bronze or stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 150 degrees C. Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

2.6.5 Strainers

Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

2.6.6 Pressure and Vacuum Gauges

Gauges shall conform to MLIT-M and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm in diameter with a range from 0 kPa to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.6.7 Temperature Gauges

Temperature gauges shall be the industrial duty type and be provided for the required temperature range. Gauges shall have Celsius scale in 1 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 1.5 m of the finished floor. Universal
adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 1.5 to 2.1 m above the finished floor. Remote element type temperature gauges shall be provided in thermal wells located 2.1 m above the finished floor.

2.6.7.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 229 mm long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.6.7.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 89 mm, stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment. Accuracy shall be one percent of dial range.

2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 89 mm, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.6.7.4 Thermal Well

Thermal well shall be identical size, 13 or 19 mm NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 13 mm NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 25 mm.

2.6.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall conform to MLIT-M.

2.6.9 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer’s standard finish, except that items located outside of buildings shall have weather resistant finishes that will withstand [125] [500] hours exposure to the salt spray test specified in JIS Z 2371 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to JIS H 8641.
2.7.2 Factory Applied Insulation

[Refrigerant suction lines between the cooler and each compressor [and cold gas inlet connections to gas cooled motors]] [Refrigerant pumps and exposed chilled water lines on absorption chillers] shall be insulated with not less than 19 mm thick unicellular plastic foam. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flamespread index no higher than 75 and a smoke developed index no higher than 150. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform a verification of dimensions in the field. Submit a letter, at least [2] [_____] weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found before performing any work.

3.2 INSTALLATION

Pipe and fitting installation shall conform to the requirements of MLIT-M. Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation are not permitted without written approval. Cut pipe or tubing square, removed by reaming, and permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.2.1 Directional Changes

Make changes in direction with fittings, except that bending of pipe 100 mm and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.2.2 Functional Requirements

Piping shall be installed 4 mm/m of pipe in the direction of flow to ensure adequate oil drainage. Open ends of refrigerant lines or equipment shall be properly capped or plugged during installation to keep moisture, dirt, or other foreign material out of the system. Piping shall remain capped until installation. Equipment piping shall be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.
3.2.3 Fittings and End Connections

3.2.3.1 Threaded Connections

Make threaded connections with tapered threads and make tight with tape complying with JIS K 7137-2 thread-joint compound applied to the male threads only.

3.2.3.2 Brazed Connections

Perform brazing in accordance with MLIT-M, except as modified herein. During brazing, fill the pipe and fittings with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Remove surplus brazing material at all joints. Make steel tubing joints in accordance with the manufacturer's recommendations. Paint joints in steel tubing with the same material as the baked-on coating within 8 hours after joints are made. Protect tubing against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Support piping prior to brazing and do not spring or force.

3.2.3.3 Welded Connections

Welded joints in steel refrigerant piping shall be fusion-welded. Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to JIS Z 3821. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with JWES-Welding Technology Education Sheet or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.2.3.4 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.2.3.5 Flanged Connections

When steel refrigerant piping is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment requiring maintenance, such as compressors, coils, chillers, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for use with the refrigerants to be handled.

3.2.4 Valves

3.2.4.1 General

Refrigerant stop valves shall be installed on each side of each piece of equipment such as compressors condensers, evaporators, receivers, and other similar items in multiple-unit installation, to provide partial system
isolation as required for maintenance or repair. Stop valves shall be installed with stems horizontal unless otherwise indicated. Ball valves shall be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches shall be external to thermal insulation. Safety switches shall not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves shall be provided at all points of systems where accumulated noncondensable gases would prevent proper system operation. Valves shall be furnished to match line size, unless otherwise indicated or approved.

3.2.4.2 Expansion Valves

Expansion valves shall be installed with the thermostatic expansion valve bulb located on top of the suction line when the suction line is less than 54 mm in diameter and at the 4 o'clock or 8 o'clock position on lines larger than 54 mm. The bulb shall be securely fastened with two clamps. The bulb shall be insulated. The bulb shall be installed in a horizontal portion of the suction line, if possible, with the pigtail on the bottom. If the bulb must be installed in a vertical line, the bulb tubing shall be facing up.

3.2.4.3 Valve Identification

Each system valve, including those which are part of a factory assembly, shall be tagged. Tags shall be in alphanumeric sequence, progressing in direction of fluid flow. Tags shall be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 40 mm diameter, substantially attached to a component or immediately adjacent thereto. Tags shall be attached with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Tag numbers shall be referenced in Operation and Maintenance Manuals and system diagrams.

3.2.5 Vibration Dampers

Vibration damper shall be provided in the suction and discharge lines on spring mounted compressors. Vibration dampers shall be installed parallel with the shaft of the compressor and shall be anchored firmly at the upstream end on the suction line and the downstream end in the discharge line.

3.2.6 Strainers

Strainers shall be provided immediately ahead of solenoid valves and expansion devices. Strainers may be an integral part of an expansion valve.

3.2.7 Filter Dryer

A liquid line filter dryer shall be provided on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Dryers shall be sized in accordance with the manufacturer's recommendations for the system in which it is installed. Dryers shall be installed such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Dryers shall be installed in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.
3.2.8 Sight Glass

A moisture indicating sight glass shall be installed in all refrigerant circuits downstream of all filter dryers and where indicated. Site glasses shall be full line size.

3.2.9 Discharge Line Oil Separator

Discharge line oil separator shall be provided in the discharge line from each compressor. Oil return line shall be connected to the compressor as recommended by the compressor manufacturer.

3.2.10 Accumulator

Accumulators shall be provided in the suction line to each compressor.

3.2.11 Flexible Pipe Connectors

Connectors shall be installed perpendicular to line of motion being isolated. Piping for equipment with bidirectional motion shall be fitted with two flexible connectors, in perpendicular planes. Reinforced elastomer flexible connectors shall be installed in accordance with manufacturer's instructions. Piping guides and restraints related to flexible connectors shall be provided as required.

3.2.12 Temperature Gauges

Temperature gauges shall be located specifically on, but not limited to the following: [the sensing element of each automatic temperature control device where a thermometer is not an integral part thereof] [the liquid line leaving a receiver] [and] [the suction line at each evaporator or liquid cooler]. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 25 mm.

3.2.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MLIT-M, except as modified herein. Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.2.13.1 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MLIT-M and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. [Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 23 kg shall have the excess hanger loads suspended from panel points.]

3.2.13.2 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 4.5 m not more than 2.4 m from end of risers, and at vent terminations.
3.2.13.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.2.13.4 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Building equipment seismic design & construction guidelines 2014 Edition.

3.2.13.5 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Masonry anchors for overhead applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section.

3.2.14 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m on each side of each expansion joint, and in lines 100 mm or smaller not more than 600 mm on each side of the joint.

3.2.15 Pipe Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Detailed drawings of pipe anchors shall be submitted for approval before installation.

3.2.16 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to JIS G 3302, 1.0 mm (20 gauge). Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to JIS G 3454, [Schedule 30] [Schedule 20] [Standard weight]. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 13 mm depth. Sleeves shall not be installed in structural members.

3.2.16.1 Refrigerated Space

Refrigerated space building surface penetrations shall be fitted with
sleeves fabricated from hand-lay-up or helically wound, fibrous glass reinforced polyester or epoxy resin with a minimum thickness equal to equivalent size Schedule 40 steel pipe. Sleeves shall be constructed with integral collar or cold side shall be fitted with a bonded slip-on flange or extended collar. In the case of masonry penetrations where sleeve is not cast-in, voids shall be filled with latex mixed mortar cast to shape of sleeve and flange/external collar type sleeve shall be assembled with butyl elastomer vapor barrier sealant through penetration to cold side surface vapor barrier overlap and fastened to surface with masonry anchors. Integral cast-in collar type sleeve shall be flashed [with not less than 100 mm of cold side vapor barrier overlap of sleeve surface.] Normally noninsulated penetrating round surfaces shall be sealed to sleeve bore with mechanically expandable seals in vapor tight manner and remaining warm and cold side sleeve depth shall be insulated with not less than [100] [_____] mm of foamed-in-place rigid polyurethane or foamed-in-place silicone elastomer. Vapor barrier sealant shall be applied to finish warm side insulation surface. Warm side of penetrating surface shall be insulated beyond vapor barrier sealed sleeve insulation for a distance which prevents condensation. Wires in refrigerated space surface penetrating conduit shall be sealed with vapor barrier plugs or compound to prevent moisture migration through conduit and condensation therein.

3.2.16.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 6 mm all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07 92 00 JOINT SEALANTS.

3.2.16.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 5.17 kg/sq. m copper sleeve, or a 0.81 mm thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 200 mm from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 50 mm above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

3.2.16.3.1 Waterproofing Clamping Flange

Pipes up to and including 250 mm in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.2.16.3.2 Modular Mechanical Type Sealing Assembly

In lieu of a waterproofing clamping flange and caulking and sealing of
annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.2.16.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.

3.2.16.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.2.17 Access Panels

Access panels shall be provided for all concealed valves, vents, controls, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.2.18 Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.19 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.2.19.1 Color Coding

Color coding for piping identification is specified in Section 09 90 00 PAINTS AND COATINGS.

3.2.19.2 Color Coding Scheme

A color coding scheme for locating hidden piping shall be in accordance with [Section 22 00 00 PLUMBING, GENERAL PURPOSE][Section 22 00 70 PLUMBING, HEALTHCARE FACILITIES].
3.2.20 Identification Tags

Provide identification tags made of brass, engraved laminated plastic or engraved anodized aluminum indicating service and item number on all valves and dampers. Tags shall be 35 mm minimum diameter and marking shall be stamped or engraved. Indentations shall be black for reading clarity. Tags shall be attached to valves with No. 12 AWG copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.3 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter shall be considered contaminated systems. Restoring contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, shall be performed using currently approved refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Government as determined by the Contracting Officer. Water shall not be used in any procedure or test.

3.4 TRAINING COURSE

a. Submit a schedule, at least [2] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training. Conduct a training course for [_____] members of the operating staff as designated by the Contracting Officer. The training period shall consist of a total [_____] hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

b. The field posted instructions shall cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

c. Submit [6] complete copies of an operation manual in bound 216 by 279 booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least [4] weeks prior to the first training course. The booklets shall include the manufacturer's name, model number, and parts list. The manuals shall include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

d. Submit [6] complete copies of maintenance manual in bound 216 by 279 booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals shall include piping layouts and simplified wiring and control diagrams of the system as installed.

3.5 REFRIGERANT PIPING TESTS

After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Submit a schedule, at least [2] weeks prior to the start of related testing, for each
test. Identify the proposed date, time, and location for each test. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit [6] [_____] copies of the tests report in bound 216 by 279 mm booklets documenting all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.

3.5.1 Preliminary Procedures

Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.

3.5.2 Pneumatic Test

Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 55 degrees C dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 69 kPa with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure, with a maximum test pressure 25 percent greater. Pressure above 690 KPa shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24 hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 2 kPa will be allowed for each degree C change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, remelting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

3.5.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, the pressure shall be relieved and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 2 degrees C. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, then the system shall be evacuated again down to 300
micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

3.5.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

3.5.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

3.5.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 85 g of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Government including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 1518 (2013) Rolling Bearings-Dynamic Load Ratings and Rating Life
JIS B 1521 (2012) Rolling Bearings-Deep Groove Ball Bearings
JIS B 1534 (2013) Rolling Bearings-Tapered Roller Bearings
JIS B 8608 (1994) Refrigerating Systems-Test Methods-General Requirements
JIS B 8267 (2015) Construction of Pressure Vessel
JIS B 8613 (1994) Water Chilling Unit
JIS B 8623 (2002) Testing Methods of Refrigerant Condensing Units
JIS C 4212 (2010) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)
JIS G 3101 (2017) Rolled Steels for General Structure (Amendment 1)
JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip
JIS H 8641 (2007) Hot Dip Galvanized Coatings
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval or for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
   Water Chiller; G
   Water Chiller – Field Acceptance Test Plan

SD-06 Test Reports
   Field Acceptance Testing
   Water Chiller – Field Acceptance Test Report
   System Performance Tests

SD-07 Certificates
   Refrigeration System;

SD-10 Operation and Maintenance Data
   Operation and Maintenance Manuals

1.3 CERTIFICATIONS

1.3.1 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified Technician to meet requirements in Refrigerant Handling Technician (Reibai-Furonrui-Toriatsukai Gijutsusha) under Japan Refrigeration and Air-Conditioning Industry Association. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to
operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with JIS B 6801.

1.5 DELIVERY, STORAGE, AND HANDLING

Stored items must be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation will be the Contractor's responsibility. Any materials found to be damaged must be replaced at the Contractor's expense. During installation, piping and similar openings must be capped to keep out dirt and other foreign matter.

1.6 PROJECT REQUIREMENTS

1.6.1 Verification of Dimensions

The Contractor must become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment will be standard Commercial cataloged products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. These products must have a two year record of satisfactory field service prior to bid opening. The two year record of service must include applications of equipment and materials under similar circumstances and of similar size. Products having less than a two year record of satisfactory field service will be acceptable if a certified record of satisfactory field service for not less than 6000 hours can be shown. The 6000 hour service record must not include any manufacturer's prototype or factory testing. Satisfactory field service must have been completed by a product that has been, and presently is being sold or offered for sale on the commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures. Equivalent shall be supported by a product representative and service organization located in Japan.

2.2 MANUFACTURER'S STANDARD NAMEPLATES

[ Major equipment including chillers, compressors, compressor drivers, condensers, water coolers, receivers, refrigerant leak detectors, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life. Plates must be fixed in prominent locations with nonferrous screws or bolts.]

[ Nameplates are required on major components if the manufacturer needs to provide specific engineering and manufacturing information pertaining to the particular component. Should replacement of this component be required, nameplate information will insure correct operation of the unit after replacement of this component.]
2.3 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, must be provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with JIS C 4212.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212.

d. Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. [Motor bearings must be fitted with grease supply fittings and grease relief to outside of the enclosure.] Motor enclosure type may be either TEAO or TEFC.

2.4 SELF-CONTAINED WATER CHILLERS, VAPOR COMPRESSION TYPE

Unless necessary for delivery purposes, units must be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the factory. In lieu of delivery constraints, a chiller may be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the job site by a factory representative. Unit components delivered separately must be sealed and charged with a nitrogen holding charge. Parts weighing 23 kg or more which must be removed for inspection, cleaning, or repair, such as motors, gear boxes, cylinder heads, casing tops, condenser, and cooler heads, must have lifting eyes or lugs. Chiller must be provided with a single point wiring connection for incoming power supply. Chiller's condenser and water cooler must be provided with [standard] water boxes with [grooved mechanical] [flanged] [welded] connections.

2.4.1 Scroll, Reciprocating, or Rotary Screw Type

Chiller must be certified for performance per JIS B 8613. The chiller's performance must be rated in accordance with JIS B 8613. Chiller must conform to Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). As a minimum, chiller must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil
b. Structural base

c. Chiller refrigerant circuit

d. Controls package

e. Scroll, reciprocating, or rotary screw compressor

f. Compressor driver, [electric motor] [gas-engine]

g. Compressor driver connection

h. Water cooler (evaporator)

i. [Air][Water]-cooled condenser coil

j. Heat recovery condenser

k. Receiver

l. Tools

2.4.2 Centrifugal or Rotary Screw Type

Chiller must be certified for performance per JIS B 8613. The chiller's performance must be rated in accordance with JIS B 8613. Chiller must conform to Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). As a minimum, chiller must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil

b. Structural base

c. Chiller refrigerant circuit

d. Controls package

e. Centrifugal or rotary screw compressor

f. Compressor driver, [electric motor] [gas-engine] [steam turbine]

g. Compressor driver connection

h. Water cooler (evaporator)

i. [Air][Water]-cooled condenser coil

j. Heat recovery condenser coil

k. Receiver

l. Purge system for chillers which operate below atmospheric pressure

m. Tools

2.5 SPLIT-SYSTEM WATER CHILLER, VAPOR COMPRESSION TYPE

Total chiller system must be certified for performance per JIS B 8613.
Individual chiller components must be constructed and rated in accordance with the applicable JRA standards. Chiller system must conform to Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). The construction of chiller must be MLIT-M compliant. The manufacturer must provide certification of compliance. Chiller must be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the job site in strict accordance with manufacturer's recommendations. Unit assembly must be completed in strict accordance with manufacturer's recommendations. Chiller must operate within capacity range and speed recommended by the manufacturer. Parts weighing 23 kg or more which must be removed for inspection, cleaning, or repair, must have lifting eyes or lugs. Chiller must include all customary auxiliaries deemed necessary by the manufacturer for safe, controlled, automatic operation of the equipment. Chiller's water cooler must be provided with [standard] [marine] water boxes with [grooved mechanical] [flanged] [welded] connections. Chillers must operate at partial load conditions without increased vibration over normal vibration at full load, and must be capable of continuous operation down to minimum capacity. As a minimum, chiller must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil
b. Structural base
c. Chiller refrigerant circuit
d. Controls package
e. Receiver
f. Tools

2.5.1 Compressor-Chiller Unit

As a minimum, the compressor-chiller unit must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Scroll, reciprocating, or rotary screw compressor
b. Compressor driver, electric motor
c. Compressor driver connection
d. Water cooler (evaporator)

2.5.2 Condensing Unit

As a minimum, the condensing unit must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Scroll, reciprocating, or rotary screw compressor
b. Compressor driver, electric motor
c. Compressor driver connection
d. Air or water cooled condenser
2.5.3 Remote Air-Cooled Condenser

Condenser must be a factory-fabricated and assembled unit, consisting of coils, fans, and condenser fan motors. Condenser must be rated in accordance with JIS B 8623. [Unless the condenser coil is completely protected through inherent design, louvered panel coil guards must be provided by the manufacturer to prevent physical damage to the coil.] Manufacturer must certify that the condenser and associated equipment are designed for the submitted condensing temperature. For design conditions, if matched combination catalog ratings matching remote condensers to compressors are not available, the Contractor must furnish a crossplotting of the gross heat rejection of the condenser against the gross heat rejection of the compressor, for the design conditions to show the compatibility of the equipment furnished.

2.5.3.1 Condenser Casing

Condenser casing must be aluminum not less than [1.016] [2.032] mm or hot-dip galvanized steel not lighter than 18 gauge 1.311 mm or JIS G 3302. [Condensers having horizontal air discharge must be provided with discharge baffle to direct air upward, constructed of the same material and thickness as the casing].

2.5.3.2 Coil

[Condenser coil must be of the extended-surface fin-and-tube type and must be constructed of seamless [copper] [or] tubes with compatible [copper] [or] [aluminum] fins. Fins must be soldered or mechanically bonded to the tubes and installed in a metal casing. Coils must be circuited and sized for a minimum of 3 degrees C subcooling and full pumpdown capacity. Coil must be factory leak and pressure tested after assembly in accordance with or in Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese Standard product][The condenser coil must be of the microchannel heat exchanger technology (MCHX) type consisting of a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds in a two-pass arrangement. Provide coils constructed of aluminum alloys for fins, tubes, and manifolds. Coil must be factory leak and pressure tested after assembly in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese product.]

Coil must be entirely coated in accordance with the requirements of paragraph COIL CORROSION PROTECTION.

2.5.3.3 Fans

Provide propeller type fans as best suited for the application. Fans must be direct. Fans must be statically and dynamically balanced.

2.5.3.4 Condenser Sizing

Size condensers for full capacity at 16.67 degrees C temperature difference between entering outside air and condensing refrigerant. Subcooling must not be considered in determining compressor and condenser capacities. For design conditions, submit a cross-plot of net refrigeration effect of compressor to establish net refrigeration effect and compatibility or JIS B 8608 of equipment furnished.
2.5.3.5 Low Ambient Control

Provide factory mounted head pressure control for operation during low ambient conditions. Head pressure must be controlled by [fan cycling,] [fan speed control,]. Low ambient control must permit compressor operation below [4.4 degrees C] [_____] degrees C.

2.5.3.6 High Ambient Unloading

Provide unloading capability to allow operation in high ambient conditions [_____] degrees C above design conditions.

2.5.4 Remote Water-Cooled Condenser

Condenser must be a factory-fabricated and assembled unit constructed and rated in accordance with JIS B 8623. Condenser may be of either the shell-and-coil or shell-and-tube type design. Condenser's refrigerant side must be designed and factory pressure tested to comply with in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese standard. Condenser's water side must be designed and factory pressure tested. Condensers must be complete with pressure relief valve or rupture disk, water drain connections, refrigerant charging valve, refrigerant valves, liquid-level indicating devices, and stand or saddle. Low pressure refrigerant condenser must be provided with a purge valve located at the highest point in the condenser to purge non-condensibles trapped in the condenser. Condenser shell must be constructed of seamless or welded steel. Coil bundles must be totally removable and arranged to drain completely. Tubes may be either seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Each tube must be individually replaceable, except for the coaxial tubes. Tubes must be installed into carbon mild steel tube sheets by rolling. Tube baffles must be properly spaced to provide adequate tube support and cross flow. Condenser performance must be based on water velocities per JIS B 8623 and a fouling factor per JIS B 8613. Water-cooled condensers may be used for refrigerant storage in lieu of a separate liquid receiver, if the condenser storage capacity is 20 percent in excess of the fully charged system for remote water cooled condensers. As a minimum, the condenser must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Liquid-level indicating devices.

b. Companion flanges, bolts, and gaskets for flanged water connections.

2.6 CHILLER COMPONENTS

2.6.1 Refrigerant and Oil

Refrigerants must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese standard. CFC-based refrigerants are prohibited. Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0, with the exception of R-123. Provide SDS sheets for all refrigerants.

2.6.2 Structural Base

Chiller and individual chiller components must be provided with a factory-mounted structural steel base (welded or bolted) or support legs. Chiller and individual chiller components must be isolated from the...
building structure by means of [molded neoprene isolation pads.] [vibration isolators with published load ratings. Vibration isolators must have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.]

2.6.3 Chiller Refrigerant Circuit

Chiller refrigerant circuit must be completely piped and factory leak tested in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese standard. [For multicompressor units, not less than 2 independent refrigerant circuits must be provided. ]Circuit must include as a minimum a [combination filter and drier,] combination sight glass and moisture indicator, an electronic or thermostatic expansion valve with external equalizer or float valve, charging ports, compressor service valves for field-serviceable compressors, and superheat adjustment.

2.6.4 Controls Package

Provide chillers with a complete [factory-mounted] [remote-mounted where indicated], microprocessor based operating and safety control system. Controls package must contain as a minimum a digital display, an on-auto-off switch, [motor starters,] [variable frequency motor controller,] [disconnect switches,] power wiring, and control wiring. Controls package must provide operating controls, monitoring capabilities, programmable setpoints, safety controls, and [BAS] [UMCS] interfaces as defined below.

2.6.4.1 Operating Controls

Chiller must be provided with the following adjustable operating controls as a minimum.

a. Leaving chilled water temperature control
b. Adjustable timer or automated controls to prevent a compressor from short cycling
c. Automatic lead/lag controls (adjustable) for multi-compressor units
d. Load limiting
e. System capacity control to adjust the unit capacity in accordance with the system load and the programmable setpoints. Controls must automatically re-cycle the chiller on power interruption.
f. Startup and head pressure controls to allow system operation at all ambient temperatures down to [_____] degrees C.

[ g. Fan sequencing for air-cooled condenser ]

2.6.4.2 Monitoring Capabilities

During normal operations, the control system must be capable of monitoring and displaying the following operating parameters. Access and operation of display must not require opening or removing any panels or doors.

a. Entering and leaving chilled water temperatures
b. [Entering and leaving chilled water pressure] [Chilled water flow]
c. [Entering and leaving condenser water pressure] [Condenser water flow]
d. Self diagnostic
e. Operation status
f. Operating hours
g. Number of starts
h. Compressor status (on or off)
i. Compressor load (percent)
j. Refrigerant discharge and suction pressures
k. Magnetic bearing levitation status (if applicable)
l. Magnetic bearing temperatures (if applicable)
m. Oil pressure

n. Condenser water entering and leaving temperatures

2.6.4.3 Configurable Setpoints

The control system must be capable of being configured directly at the unit's interface panel. [No parameters may be capable of being changed without first entering a security access code.] The programmable setpoints must include the following as a minimum:

a. Leaving Chilled Water Temperature
b. Leaving Condenser Water Temperature
c. Time Clock/Calendar Date

2.6.4.4 Safety Controls with Manual Reset

Chiller must be provided with the following safety controls which automatically shutdown the chiller and which require manual reset.

a. Low chilled water temperature protection
b. High condenser refrigerant discharge pressure protection
c. Low evaporator pressure protection
d. Chilled water flow detection
e. High motor winding temperature protection
f. Low oil flow protection if applicable
g. Magnetic bearing controller (MBC), Internal fault (if applicable)
2.6.4.5 Safety Controls with Automatic Reset

Chiller must be provided with the following safety controls which automatically shutdown the chiller and which provide automatic reset.

a. Over/under voltage protection
b. Chilled water flow interlock
c. MBC, Vibration (if applicable)
d. MBC, No levitation (if applicable)
e. Phase reversal protection

2.6.4.6 Remote Alarm

During the initiation of a safety shutdown, a chiller's control system must be capable of activating a remote alarm bell. In coordination with the chiller, the Contractor must provide an alarm circuit (including transformer if applicable) and a minimum 100 mm diameter alarm bell. Alarm circuit must activate bell in the event of machine shutdown due to the chiller's monitoring of safety controls. The alarm bell must not sound for a chiller that uses low-pressure cutout as an operating control.

2.6.4.7 Utility Monitoring and Control System Interface

Provide a Utility Monitoring and Control System (UMCS) interface meeting the requirements of Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and the requirements of [Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS]. The interface must provide all system operating conditions, capacity controls, and safety shutdown conditions as network points. In addition, the following points must be overridable via the network interface:

a. Unit Start/Stop
b. Leaving Chilled Water Temperature Setpoint
c. Leaving Condenser Water Temperature Setpoint

2.6.5 Compressor(s)

2.6.5.1 Scroll Compressor(s)

Compressors must be of the hermetically sealed design. Compressors must be mounted on vibration isolators to minimize vibration and noise. Rotating parts must be statically and dynamically balanced at the factory to
minimize vibration. Lubrication system must be centrifugal pump type equipped with a means for determining oil level and an oil charging valve. Crankcase oil heater must be provided. [Provide continuous compressor unloading to [10 percent] [15 percent] of full-load capacity by way of variable speed compressor motor controller or variable unloading of the scroll.]

2.6.5.2 Rotary Screw Compressor(s)

Compressors must operate stably for indefinite time periods to at least 25 percent capacity reduction without gas bypass external to the compressor. Provision must be made to insure proper lubrication of bearings and shaft seals on shutdown with or without electric power supply. Rotary screw compressors must include:

a. An open or hermetic, positive displacement, oil-injected design directly driven by the compressor driver. Allow access to internal compressor components for repairs, inspection, and replacement of parts.

b. Rotors must be solid steel, possessing sufficient rigidity for proper operation.

c. A maximum rotor operating speed no greater than 3600 RPM. Provide cast iron rotor housing.

d. Casings of cast iron, precision machined for minimal clearance about periphery of rotors with minimal clearance at rotor tops and rotor ends.

e. A lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.

f. Bearing housing must be conservatively loaded and rated for an L(10) life of not less than the requirement of JIS B 1518. Shaft main bearings of the sleeve type with heavy duty bushings or rolling element type in accordance with JIS B 1521, JIS B 1534.

g. A differential oil pressure or flow cutout to allow the compressor to operate only when the required oil pressure or flow is provided to the bearings.

h. [A temperature- or pressure-initiated, hydraulically actuated, single-slide-valve, capacity-control system to provide minimum automatic capacity modulation from 100 percent to 15 percent.] [Use a Variable Frequency Drive (VFD) to modulate capacity modulation from 100 percent to 15 percent.]

i. An oil separator and oil return system to remove oil entrained in the refrigerant gas and automatically return the oil to the compressor.

j. Crankcase oil heaters must be provided.

2.6.5.3 Centrifugal Compressor(s)

Centrifugal compressors may be either single or multistage, having dynamically balanced impellers, either direct or gear driven by the compressor driver. Impellers must be over-speed tested at 1.2 times the impeller-shaft speed. Impeller shaft must be steel with sufficient rigidity for proper operation at any required operating speed. Compressors must be capable of variable speed operation and may have either oil-free
bearing drives or oil-lubricated bearing drives. Centrifugal compressors must include:

a. Shaft main bearings that are either oil lubricated, oil free ceramic or magnetic levitated. The oil lubricated bearings must be the rolling element type in accordance with JIS B 1521 JIS B 1534, journal type with bronze or babbitt liners, or of the aluminum-alloy one-piece insert type. Oil lubricated or oil free ceramic bearings must be rated for an L(10) life of not less than the JIS B 1518 requirement. Magnetic levitated main shaft bearings must be in accordance with ISO 14839-1, ISO 14839-2, ISO 14839-3, ISO 14839-4, and provided with radial and axial magnetic levitated bearings (combination permanent and electro magnets) to levitate the shaft thereby eliminating metal to metal contact and thus eliminating the need for oil. The active magnetic bearings must be equipped with an automatic vibration reduction and balancing system. Each bearing position must be sensed by position sensors and provide real time positioning of the rotor shaft, controlled by on-board digital electronics. In the event of a power failure, the magnetic bearings will remain in operation throughout the compressor coast-down using a reserve power supply. Provide mechanical bearings designed for emergency touchdowns, as a backup to the magnetic bearings.

b. Casing of cast iron, aluminum, or steel plate with split sections gasketed and bolted or clamped together.

c. Lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.

d. Provisions to ensure proper lubrication of bearings and shaft seals prior to starting and upon stopping with or without electric power supply (if applicable). On units providing forced-feed lubrication prior to starting, a differential oil pressure cutout interlocked with the compressor starting equipment must allow the compressor to operate only when the required oil pressure is provided to the bearings (if applicable).

e. Oil sump heaters controlled as recommended by the manufacturer.

f. Temperature-or pressure-actuated prerotation vane, variable geometry diffuser or suction damper to provide automatic capacity modulation from 100 percent capacity to 25 percent capacity. If operation to 25 percent capacity cannot be achieved without providing gas bypass external to the compressor, then the Contractor must indicate in the equipment submittal the load percent at which external hot gas bypass is required to prevent surge and to provide the specified capacity reduction and its impact on performance.

2.6.6 Compressor Driver, Electric Motor

Components such as motors, [starters], [variable speed drives] and wiring must be in accordance with paragraph ELECTRICAL WORK. [Motor starter][Variable frequency drive] must be [unit mounted] [remote mounted] as indicated with [starter][variable frequency drive] type, wiring, and accessories coordinated with the chiller manufacturer.

2.6.7 Compressor Driver Connections

[ Each compressor must be driven by a V-belt drive or direct connected
through a flexible coupling, except that flexible coupling is not required on hermetic units. V-belt drives must be designed for not less than 150 percent of the driving motor capacity. Flexible couplings must be of the type that does not require lubrication. ] Each machine driven through speed-increasing gears must be so designed as to assure self-alignment, interchangeable parts, proper lubrication system, and minimum unbalanced forces. Bearings must be of the sleeve or roller type. Gear cases must be oil tight. Shaft extensions must be provided with seals to retain oil and exclude all dust.

2.6.8 Water Cooler (Evaporator)

Cooler must be of the shell-and-coil or shell-and-tube type design. Cooler shell must be constructed of seamless or welded steel. Coil bundles must be totally removable and arranged to drain completely. Tubes must be seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Each tube must be individually replaceable. Tubes must be installed into carbon mild steel tube sheets by rolling. Tube baffles must be properly spaced to provide adequate tube support and cross flow. Performance must be based on a water velocity not less than 0.91 m/s nor more than 3.7 m/s and a fouling factor per JIS B 8613.

Brazed plate heat exchanger must be constructed of 304 or 316 stainless steel, designed to a refrigerant-side working pressure of 3,000 kPa and a waterside working pressure of 1,000 kPa. Evaporator must be factory tested at 1.1 times maximum allowable refrigerant side working pressure and 1.5 times maximum allowable water side working pressure. Provide cooler heaters to protect the evaporator to an ambient of minus 29 degrees C. Provide cooler with factory-installed flow switches. All water connections must use either flanged or grooved-pipe connections. Factory insulate all cold surfaces.

2.6.9 Air-Cooled Condenser Coil

[Condenser coil must be of the extended-surface fin-and-tube type and must be constructed of seamless [copper] [or] [aluminum] tubes with compatible [copper] [or] [aluminum] fins. Fins must be soldered or mechanically bonded to the tubes and installed in a metal casing. Coils must be circuited and sized for a minimum of 3 degrees C subcooling and full pumpdown capacity. Coil must be factory leak and pressure tested after assembly in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).][The condenser coil must be of the microchannel heat exchanger technology (MCHX) type consisting of a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds in a two-pass arrangement. Provide coils constructed of aluminum alloys for fins, tubes, and manifolds. Coil must be factory leak and pressure tested after assembly in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).]

Coil must be entirely coated in accordance with the requirements of paragraph COIL CORROSION PROTECTION.

2.6.10 Water-Cooled Condenser Coil

Condenser must be of the shell-and-coil or shell-and-tube type design. Condenser's refrigerant side must be designed and factory pressure tested to comply with in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). Condenser's water side must be designed and factory pressure tested for not less than [1,000] [1,700] [2000] kPa.
Condensers must be complete with refrigerant relief valve/rupture disc assembly, water drain connections, and refrigerant charging valve. Low pressure refrigerant condenser must be provided with a purging device to purge non-condensibles trapped in the condenser while keeping refrigerant emissions below requirements of MLIT-M. Purge units must be certified per MLIT-M. Condenser shell must be constructed of seamless or welded steel. Coil bundles must be totally removable and arranged to drain completely. Tubes must be seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Each tube must be individually replaceable, except for the coaxial tubes. Tube baffles must be properly spaced to provide adequate tube support and cross flow. Performance must be based on water velocities not less than 0.91 m/s nor more than 3.7 m/s and a fouling factor per JIS B 8613. Water-cooled condensers may be used for refrigerant storage in lieu of a separate liquid receiver, if the condenser storage capacity is 5 percent in excess of the fully charged system for single packaged systems.

2.6.11 Heat Recovery Condenser Coil

Condenser must be of the shell-and-coil or shell-and-tube type design and must not be a part of the standard condenser. Condenser must be provided and installed by the chiller manufacturer. Condenser's refrigerant side must be designed and factory pressure tested to comply with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). Condenser's water side must be designed and factory pressure tested for not less than [1,000] [1,700] [2000] kPa. Condenser must have performance characteristics as indicated on the drawings. Condenser shell must be constructed of seamless or welded steel. Coil bundles must be totally removable and arranged to drain completely. Tubes must be seamless copper, plain, integrally finned with smooth bore or integrally finned with enhanced bore. Each tube must be individually replaceable, except for the coaxial tubes. Tube baffles must be properly spaced to provide adequate tube support and cross flow. Performance must be based on water velocities not less than 0.91 m/s nor more than 3.7 m/s and a fouling factor per JIS B 8613.

2.6.12 Receivers

Receiver must bear a stamp certifying compliance with JIS B 8267 and must meet the requirements in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku). Inner surfaces must be thoroughly cleaned by sandblasting or other approved means. Each receiver must have a storage capacity not less than 20 percent in excess of that required for the fully-charged system. Each receiver must be equipped with inlet, outlet drop pipe, drain plug, purging valve, in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku), and two bull's eye liquid-level sight glasses. Sight glasses must be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 75 mm horizontally from the drop pipe measured along the axis of the receiver. In lieu of bull's eye sight glass, external gauge glass with metal glass guard and automatic closing stop valves may be provided.

2.6.13 Chiller Purge System

Chillers which operate at pressures below atmospheric pressure must be provided with a purge system in accordance with MLIT-M. Purge system must automatically remove air, water vapor, and non-condensible gases from the chiller's refrigerant. Purge system must condense, separate, and return all refrigerant back to the chiller. Purge system must not discharge to
occupied areas, or create a potential hazard to personnel. Purge system
must include a purge pressure gauge, number of starts counter, and an
elapsed time meter. Purge system must include lights or an alarm which
indicate excessive purge or an abnormal air leakage into chiller.

2.6.14 Tools

One complete set of special tools, as recommended by the manufacturer for
field maintenance of the system, must be provided. Tools must be mounted
on a tool board in the equipment room or contained in a toolbox as directed
by the Contracting Officer.

2.7 ACCESSORIES

2.7.1 Refrigerant Leak Detector

Detector must be the continuously-operating, halogen-specific type.
Detector must be appropriate for the refrigerant in use. Detector must be
specifically designed for area monitoring and must include [a single
sampling point] [_____] sampling points] installed where indicated.
Detector design and construction must be compatible with the temperature,
humidity, barometric pressure and voltage fluctuations of the operating
area. Detector must have an adjustable sensitivity such that it can detect
refrigerant at or above 3 parts per million (ppm). Detector must be
supplied factory-calibrated for the appropriate refrigerant(s). Detector
must be provided with an alarm relay output which energizes when the
detector detects a refrigerant level at or above the TLV-TWA (or toxicity
measurement consistent therewith) for the refrigerant(s) in use. The
detector's relay must be capable of initiating corresponding alarms and
ventilation systems as indicated on the drawings. Detector must be
provided with a failure relay output that energizes when the monitor
detects a fault in its operation. [Detector must be compatible with the
facility's Building Control Network (BCN). The BCN must be capable of
generating an electronic log of the refrigerant level in the operating
area, monitoring for detector malfunctions, and monitoring for any
refrigerant alarm conditions.]

2.7.2 Refrigerant Relief Valve/Rupture Disc Assembly

The assembly must be a combination pressure relief valve and rupture disc
designed for refrigerant usage. The assembly must be in accordance with
JIS B 8267 and in accordance with Japanese Refrigeration Safety Regulations
(Nihon-Reitou-Hoan-Kisoku). The assembly must be provided with a pressure
gauge assembly which will provide local indication if a rupture disc is
broken. Rupture disc must be the non-fragmenting type.

2.7.3 Refrigerant Signs

Refrigerant signs must be a medium-weight aluminum type with a baked enamel
finish. Signs must be suitable for indoor or outdoor service. Signs must
have a white background with red letters not less than 13 mm in height.

2.7.3.1 Installation Identification

Each new refrigerating system must be provided with a refrigerant sign
which indicates the following as a minimum:

a. Contractor's name.
b. Refrigerant number and amount of refrigerant.

c. The lubricant identity and amount.

d. Field test pressure applied.

2.7.3.2 Controls and Piping Identification

Refrigerant systems containing more than 50 kg of refrigerant must be provided with refrigerant signs which designate the following as a minimum:

a. Valves or switches for controlling the refrigerant flow [, the ventilation system,] and the refrigerant compressor(s).

b. Pressure limiting device(s).

2.7.4 Automatic Tube Brush Cleaning System

2.7.4.1 Brush and Basket Sets

One brush and basket set (one brush and two baskets) must be furnished for each condenser tube. Brushes must be made of nylon bristles, with titanium wire. Baskets must be polypropylene.

2.7.4.2 Flow-Diverter Valve

Each system must be equipped with one flow-diverter valve specifically designed for the automatic tube brush cleaning system and have parallel flow connections. The flow-diverter valve must be designed for a working pressure of [1,000][1,700][2000] kPa. End connections must be flanged. Each valve must be provided with an electrically operated air solenoid valve and position indicator.

2.7.4.3 Control Panel

The control panel must provide signals to the diverter valve at a preset time interval to reverse water flow to drive the tube brushes down the tubes and then signal the valve to reverse the water flow to drive the brushes back down the tubes to their original position. The controller must have the following features as a minimum:

a. Timer to initiate the on-load cleaning cycle.


c. Power-on indicator.

d. Diverter-position indicator.

e. Cleaning-cycle-time adjustment


2.7.5 Gaskets

Gaskets must conform to JIS F 0602 - classification for compressed sheet with nitrile binder and acrylic fibers.
2.7.6 Bolts and Nuts

Bolts and nuts, except as required for piping applications, must be in accordance with JIS G 3101. The bolt head must be marked to identify the manufacturer and the standard with which the bolt complies in accordance with JIS G 3101.

2.8 FABRICATION

2.8.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand [125] [500] hours exposure to the salt spray test specified in JIS Z 2371 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 3 mm on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to JIS H 8641.

2.8.2 Factory Applied Insulation

Chiller must be provided with factory installed insulation on surfaces subject to sweating including the water cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers may be field applied, however it must be installed to provide easy removal and replacement of heads without damage to the insulation. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation must be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket must be tested as a composite material. Jackets, facings, and adhesives must have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.8.3 Coil Corrosion Protection

Provide coil with a uniformly applied [epoxy electrodeposition] [phenolic] [vinyl] type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the application process used, and verification of conformance with the salt spray test requirement. Coating must be applied at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Salt spray test shall be in accordance with JIS Z 2371.
2.9 SUPPLEMENTAL COMPONENTS/SERVICES

2.9.1 Chilled and Condenser Water Piping and Accessories

Chilled and condenser water piping and accessories must be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS.

2.9.2 Refrigerant Piping

Refrigerant piping for split-system water chillers must be provided and installed in accordance with Section 23 23 00 REFRIGERANT PIPING.

2.9.3 Cooling Tower

Cooling towers must be provided and installed in accordance with Section 23 65 00 COOLING TOWERS AND REMOTE EVAPORATIVELY-COOLED CONDENSERS.

2.9.4 Temperature Controls

Chiller control packages must be fully coordinated with and integrated into the temperature control system indicated in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and [Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC] and [Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] into the existing air-conditioning system.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of water chiller systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with the manufacturer's written installation instructions, including the following:

(1) Water chiller - installation instructions

3.1.1 Installation Instructions

Provide manufacturer's standard catalog data, at least [5] weeks prior to the purchase or installation of a particular component, highlighted to show features such as materials, dimensions, options, performance and efficiency. Data must include manufacturer's recommended installation instructions and procedures. Data must be adequate to demonstrate compliance with contract requirements.

3.1.2 Vibration Isolation

If vibration isolation is specified for a unit, vibration isolator literature must be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

3.1.3 Posted Instructions

Provide posted instructions, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed
operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

3.1.4 Verification of Dimensions

Provide a letter including the date the site was visited, confirmation of existing conditions, and any discrepancies found.

3.1.5 System Performance Test Schedules

Provide a schedule, at least [2] [_____] weeks prior to the start of related testing, for the system performance tests. The schedules must identify the proposed date, time, and location for each test.

3.1.6 Certificates

Where the system, components, or equipment are specified to comply with requirements of Japanese Industrial Standards, proof of such compliance must be provided. The label or listing of the specified agency must be acceptable evidence.

3.1.7 Operation and Maintenance Manuals

Provide [Six] [_____] complete copies of an operation manual in bound 216 by 279 mm booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least [4] [_____] weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. [Six] [_____] complete copies of maintenance manual in bound 216 by 279 booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.1.8 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.9 Refrigeration System

3.1.9.1 Equipment

Refrigeration equipment and the installation thereof must conform to in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese standard. Necessary supports must be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, water coolers, and similar items. Compressors must be isolated from the building structure. If mechanical vibration isolators are not
provided, vibration absorbing foundations must be provided. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 150 mm concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to [_____] percent at lowest equipment rpm. Lines connected to pumps mounted on pedestal blocks must be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts must be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.9.2 Field Refrigerant Charging

a. Initial Charge: Upon completion of all the refrigerant pipe tests, the vacuum on the system must be broken by adding the required charge of dry refrigerant for which the system is designed, in accordance with the manufacturer's recommendations. Contractor must provide the complete charge of refrigerant in accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system must be replaced. After the system is fully operational, service valve seal caps and blanks over gauge points must be installed and tightened.

b. Refrigerant Leakage: If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must immediately be isolated from the remainder of the system and the refrigerant must be pumped into the system receiver or other suitable container. The refrigerant must not be discharged into the atmosphere.

c. Contractor's Responsibility: The Contractor must, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time must more than 85 g of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year must be repaired in accordance with the specified requirements including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.1.9.3 Oil Charging

Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase must be furnished. One charge must be used during the performance testing period, and upon the satisfactory completion of the tests, the oil must be drained and replaced with the second charge.
3.1.10 Mechanical Room Ventilation

Mechanical ventilation systems must be in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.1.11 Field Applied Insulation

Field installed insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.12 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative must be provided for [_____] days. The representative shall advise on the following:

a. Hermetic machines:

(1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 micrometers.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

b. Open Machines:

(1) Erection, alignment, testing, and dehydrating.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

3.3 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Provide temporary filters for all fans that are operated during construction. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. System must be maintained in this clean condition until final acceptance. Bearings must be properly lubricated with oil or grease as recommended by the manufacturer. Belts must be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions. At least one week before the official equipment warranty start date, all condenser coils on air-cooled water chillers and split-system water chillers must be cleaned in accordance with the chiller manufacturer's instructions. This work covers two coil cleanings. The condenser coils must be cleaned with an approved coil cleaner by a service technician, factory trained by the chiller manufacturer.
manufacturer. The condenser coil cleaner must not have any detrimental affect on the materials or protective coatings on the condenser coils. Testing, adjusting, and balancing must be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.4 FIELD ACCEPTANCE TESTING

3.4.1 Test Plans

a. Manufacturer's Test Plans: Within [120][_____] calendar days after contract award, submit the following plans:

   (1) Water chiller - Field Acceptance Test Plan

   Field acceptance test plans must be developed by the chiller manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

   The Contracting Officer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance tests of the chiller and subsequent test reporting.

b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of tower system controls which interlock and interface with controls for the equipment provided under [Section 23 09 53.00 20, SPACE TEMPERATURE CONTROL SYSTEMS or Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS].

c. Prerequisite testing: Chillers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

   Each test plan must include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures must be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

   Controller must be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.
e. Performance variables: Each test plan must list performance variables that are required to be measured or tested as part of the field test. Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Chiller manufacturer must furnish with each test procedure a description of acceptable results that have been verified. Chiller manufacturer must identify the acceptable limits or tolerance within which each tested performance variable must acceptably operate.

f. Job specific: Each test plan must be job specific and must address the particular cooling towers and particular conditions which exist in this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Each test plan must include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.4.2 Testing

a. Each water chiller system must be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

(1) Water chiller - Field Acceptance Test Report

b. Manufacturer's recommended testing: Conduct the manufacturer's recommended field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.

c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.

d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment must be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative must review, approve, and sign the report of the manufacturer's recommended test. Signatures must be accompanied by the person's name typed.

f. Deficiency resolution: The test requirements acceptably met;
deficiencies identified during the tests must be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.5 SYSTEM PERFORMANCE TESTS

[Six] [_____] copies of the report must be provided in bound 216 by 279 mm booklets.

3.5.1 General Requirements

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment must be conducted by the manufacturer's approved start-up representative experienced in system start-up and testing, at such times as directed. Tests must cover a period of not less than 48 hours for each system and must demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments must be made as necessary and tests must be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points must be installed and tightened. Any refrigerant lost during the system startup must be replaced. If tests do not demonstrate satisfactory system performance, deficiencies must be corrected and the system must be retested. Tests must be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test must be provided by the Contractor. Field tests must be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.5.2 Test Report

The report must document compliance with the specified performance criteria upon completion and testing of the system. The report must indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report must also include the following information and must be taken at least three different times at outside dry-bulb temperatures that are at least 3 degrees C apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:

   (1) The refrigerant used in the system.
   (2) Condensing temperature and pressure.
   (3) Suction temperature and pressure.
   (4) Running current, voltage and proper phase sequence for each phase of all motors.
   (5) The actual on-site setting of all operating and safety controls.
   (6) Chilled water pressure, flow and temperature in and out of the chiller.
   (7) The position of the [capacity-reduction gear] at machine off, one-third loaded, one-half loaded, two-thirds loaded, and fully loaded.

3.6 DEMONSTRATIONS

Contractor must conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of
a total [_____] hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The training course must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

Provide a schedule, at least [2] [_____] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 1178 (2015) Foundation Bolts (Amendment 1)
JIS B 1180 (2014) Hexagon Head Bolts and Hexagon Head Screws
JIS B 1181 (2014) Hexagon Nuts and Hexagon Thin Nuts
JIS B 2011 (2013) Bronze, Gate, Globe, Angle, and Check Valves (Amendment 2)
JIS B 2031 (2015) Gray Cast Iron Valves (Amendment 1)
JIS B 2032 (2013) Wafer Type Rubber-Seated Butterfly Valves
JIS B 2220 (2012) Steel Pipe Flanges
JIS B 2301 (2013) Screwed Type Malleable Cast Iron Pipe Fittings
JIS B 2311 (2015) Steel Butt-Welding Pipe Fittings for Ordinary Use
JIS B 2316 (2017) Steel Socket-Welding Pipe Fittings
JIS B 2352 (2013) Bellows Type Expansion Joints
Pipe Flanges


JIS B 8285 (2010) Welding Procedure Qualification Test for Pressure Vessels

JIS B 8301 (2009) Technical Specifications for Centrifugal Pumps-Class II

JIS B 8308 (2009) Technical Specifications for Centrifugal Pumps-Class II


JIS B 8414 (2011) Relief Valves for Hot Water Appliances (Amendment 3)

JIS C 4212 (2010) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)


JIS G 3106 (2017) Rolled Steels for Welded Structure (Amendment 1)

JIS G 3201 (2008) Carbon Steel Forgings for General Use (Amendment 1)

JIS G 3202 (2008) Carbon Steel Forgings for Pressure Vessels (Amendment 1)

JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip

JIS G 3454 (2019) Carbon Steel Pipes for Pressure Service (Amendment 1)


JIS G 4051 (2018) Carbon Steels for Machine Structural Use (Amendment 1)

JIS G 4053 (2018) Low-Alloyed Steels for Machine Structural Use (Amendment 1)

JIS G 4107 (2015) Alloy Steel Bolting Materials for High Temperature Service (Amendment 1)

JIS G 4303 (2012) Stainless Steel Bars
JIS H 3300 (2018) Copper and Copper Alloy Seamless Pipes and Tubes
JIS H 3401 (2001) Pipe Fittings of Copper and Copper Alloys
JIS H 5120 (2016) Copper and Copper Alloy Castings
JIS K 0102 (2019) Testing Methods for Industrial Wastewater (Amendment 1)
JIS K 2234 (2018) Engine Antifreeze Coolants
JIS R 3453 (2006) Compressed Fiber Jointing (Amendment 1)
JIS Z 3197 (2012) Test Methods for Soldering Fluxes
JIS Z 3202 (2007) Copper and Copper Alloy Gas Welding Rods

THE SOCIETY OF HEATING AIR CONDITIONING SANITARY ENGINEERS OF JAPAN

SHASE-S003 (2012) Sleave Type Expansion Pipe Joints

MLIT MECHANICAL STANDARD SPECIFICATION


WATER SUPPLY LAW

PSCP Performance Standard Compliant Product
CCPV (2016) Construction Code of Pressure Vessel
1.2 SYSTEM DESCRIPTION

Provide the water systems having the minimum service (design) temperature-pressure rating indicated. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of MLIT-M except as modified or supplemented by this specification section or design drawings. This specification section covers the water systems piping which is located within, on, and adjacent to building(s) within the building(s) 1.66 meter line.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
Pumps; G[[]]

SD-06 Test Reports
Piping Welds NDE Report
Pressure Tests Reports; G[[]]

Report shall be provided in bound 216 by 279 mm booklets. In the reports, document all phases of the tests performed. Include initial test summaries, all repairs/adjustments made, and the final test results.

Condenser Water Quality Test Reports; G[[]]

Test reports, each month for a period of one year after project completion, in bound 216 by 279 mm booklets. In the reports, identify the chemical composition of the condenser water. Also include the comparison of the manufacturer's recommended operating conditions for the cooling tower and condenser in relation to the condition of the condenser water. Document in the report any required corrective action taken.

One-Year Inspection Report For Cooling Water; G[[]]

At the completion of one year of service, in bound 216 by 279 mm inch booklets. In the report, identify the condition of each cooling tower and condenser. Include a comparison of the condition of the cooling tower and condenser with the manufacturer's recommended operating conditions. Identify all actions taken by the Contractor and manufacturer to correct deficiencies during the first year of service.

SD-10 Operation and Maintenance Data
Requirements for data packages are specified Section 01 78 23 OPERATION AND MAINTENANCE DATA, except as supplemented and modified by this specification section.

Submit spare parts data for each different item of equipment specified, with operation and maintenance data packages. Include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Submit a list of qualified permanent service organizations with operation and maintenance data packages. Include service organization addresses and service area or expertise. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

Water Treatment Systems

An operation manual in bound 216 by 279 mm booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include testing procedures used in determining water quality.

A maintenance manual in bound 216 by 279 mm booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide.

Calibrated Balancing Valves, Data Package 3;
Automatic Flow Control Valves, Data Package 3;
Pump Discharge Valve, Data Package 2;
Water Temperature Mixing Valve, Data Package 3;
Water Temperature Regulating Valves, Data Package 3;
Water Pressure Reducing Valve, Data Package 3;
Pressure Relief Valve, Data Package 2;
Combination Pressure and Temperature Relief Valves, Data Package 2;
Expansion Joints, Data Package 2;
Pumps, Data Package 3; G[[]]
Combination Strainer and Pump Suction Diffuser, Data Package 2;
Expansion Tanks, Data Package 2; G[[]]
Air Separator Tanks, Data Package 2; G[[]]

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1.4 MODIFICATIONS TO REFERENCES

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.
1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening.

The two year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures.

Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. System components shall be environmentally suitable for the indicated locations.

The equipment items shall be supported by service organizations. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.2 STEEL PIPING

Water piping shall be steel pipe. Provide steel piping with a Japanese Industrial Standards (JIS) Class 125 service rating, which for 66 degrees C the pressure rating is 1207 kPa.

2.2.1 Pipe

Steel pipe, conform to JIS G 3454, Schedule 40 and MLIT-M.

2.2.2 Fittings and End Connections (Joints)

Piping and fittings 25 mm and smaller shall have threaded connections. Piping and fittings larger than 25 mm and smaller than 80 mm shall have either threaded, [grooved,] or welded connections. Piping and fittings 80 mm and larger shall have [grooved,] welded, or flanged connections. The
manufacturer of each fitting shall be permanently identified on the body of the fitting.

2.2.2.1 Threaded Connections

Use threaded fitting conforming to JIS B 2301. Use threaded unions conforming to JIS B 2301. Use threaded pipe nipples conforming to MLIT-M.

2.2.2.2 Flanged Connections

Flanges shall conform to JIS B 2220. Gaskets shall be nonasbestos compressed material in accordance with JIS B 2404, 1.59 mm thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to JIS B 1180.

2.2.2.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to JIS B 2301. Butt-welded fittings shall conform to JIS B 2311. Socket-welded fittings shall conform to JIS B 2316. Welded fittings shall be identified with the appropriate grade and marking symbol.

2.2.2.4 Grooved Mechanical Connections For Steel

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 110 degrees C. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Use fitting and coupling houses of malleable iron conforming to JIS G 5705; steel conforming JIS G 3454. Use gaskets of molded synthetic rubber with central cavity, pressure responsive configuration and conforming to MLIT-M. Grooved mechanical connections shall conform to MLIT-M. Coupling nuts and bolts shall be steel and shall conform to MLIT-M. Pipe connections and fittings shall be the product of the same manufacturer. Provide joint installation be in compliance with joint manufacturer's written instructions.

2.2.2.5 Dielectric Waterways and Flanges

Provide dielectric waterways with a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test. Provide dielectric waterways constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Provide dielectric flanges with the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for dielectric waterways.
2.3 PIPING FOR STEAM AND CONDENSATE

Steam and condensate piping for 1034-, 2413-, 13790-, 41369-kilopascal service shall be black carbon steel (BCS). Steam and condensate piping includes fittings, unions, flanges, gaskets, and bolting.

2.3.1 Type BCS-150 (1034 kilopascal Service)

Pipe or tube (DN6 through DN25): Schedule 40 for steam, Schedule 80 for condensate, seamless black carbon steel, conforming to JIS G 3456.

Fittings (DN6 through DN50): 2068 kilopascal working steam pressure (wsp) banded malleable iron, screwed end, conforming to JIS G 5705 and JIS B 2301.

Fittings (DN6 through DN50): 15- or 20-megapascal water, oil, or gas (wog) forged carbon steel, socket weld or screwed end, conforming to JIS G 3201 and JIS G 3202 and JIS B 2316.

Fittings (DN65 through DN250): Wall thickness to match pipe, long radius, butt weld, black carbon steel, conforming to JIS B 2313, Grade WPB, and JIS B 2313.

Unions (DN6 through DN50): 1724 kilopascal wsp, malleable iron, screwed end, ground joint, with brass or bronze seat insert, conforming to JIS B 2301.

Unions (DN6 through DN50): 15- or 20-megapascal wog, forged carbon steel; socket weld through 50 millimeter, screwed end through 25 millimeter, conforming to JIS G 3201 and JIS G 3202 and JIS B 2316, with ground joint and stainless-steel seat insert.

Flanges (DN65 through DN250): 1034-kilopascal, forged carbon steel, welding neck, with raised face or flat face and concentric finish, conforming to JIS G 3201 and JIS G 3202.

Flange Gaskets: Compressed non-asbestos sheet conforming to JIS F 0602, Type 1, P1161A or JIS R 3453, coated on both sides with graphite or similar lubricant, containing not less than 75-percent non-asbestos fiber materials.

Bolting: Bolting and flange bolting shall be hexhead and shall conform to JIS B 1178. Heavy hex-nuts shall conform to JIS B 1181. Square-head bolts and nuts are not acceptable.

2.3.2 Type BCS-350 (2413 kilopascal Service)

Pipe or tube (DN6 through DN25): Schedule 40 for steam, Schedule 80 for condensate; seamless black carbon steel, conforming to JIS G 3456.

Fittings (DN6 through DN50): 15- or 20-megapascal wog to match pipe wall, forged carbon steel, socket weld or screwed end, conforming to JIS G 3201 and JIS G 3202 and JIS B 2316.

Fittings (DN6 through DN25): Schedule 40, long-radius, butt weld, black carbon steel, conforming to JIS B 2313, Grade WPB, and JIS B 2313.

Unions (DN6 through DN50): 15- or 20-megapascal wog to match pipe wall, forged carbon steel, socket weld through 50 millimeter, screwed end through 25 millimeter, conforming to JIS G 3201 and JIS G 3202 and JIS B 2316, with
ground joint and stainless-steel seat insert

Flanges (DN65 through DN250): 2068 kilopascal, forged carbon steel, weld neck, with raised face and concentric serrated finish, conforming to JIS G 4051

Gaskets: Spiral-wound, non-asbestos-fiber-filled, carbon steel, with centering provisions, conforming to MLIT-M.

Bolting: Heavy hex-head, carbon-steel bolts or bolt studs and semifinished heavy hexnuts, conforming to JIS B 1178.

Square-head bolts are not acceptable.

2.4 PIPING FOR HIGH-PRESSURE COMPRESSED-AIR SYSTEMS

High-pressure compressed-air condensate piping includes fittings, unions, flanges, gaskets, and bolting.

2.4.1 Type BCS-2,000 (15 megapascal Service)

Pipe or tube (DN6 through DN80): Schedule 40, seamless black carbon steel, conforming to JIS G 3456 or JIS G 3454.

Fittings (DN6 through DN40): 15 megapascal wog, forged carbon steel, socket weld, conforming to JIS G 3201 and JIS G 3202 and JIS B 2316.

Fittings (DN50 through DN80): Schedule 40, long radius, butt weld, black carbon steel, conforming to JIS B 2313 and JIS B 2313.

Flanges (DN25 through DN80): 6200 kilopascal, forged carbon steel, welding neck, with raised face and concentric serrated finish, conforming to JIS G 3201 and JIS G 3202 or JIS G 4051.

Gaskets: Spiral wound, non-asbestos-fiber-filled, carbon steel, with centering provisions, conforming to MLIT-M.

Bolting: Alloy-steel bolt studs conforming to JIS G 4107and JIS G 4303, and semifinished heavy hex-nuts, conforming to JIS G 4051, JIS G 4303 and JIS G 4053.

2.4.2 Type BCS-6,000 (41368-kilopascal Service)

Pipe or tube (DN15 through DN80): Seamless, black carbon steel, conforming to JIS G 3456, or JIS G 3454.

Fittings (DN15 through DN40): 41.3 megapascal wog, forged carbon steel, socket weld, conforming to JIS G 3201 and JIS G 3202 and JIS B 2316.

Fittings (DN50 through DN80): Long-radius, butt weld, black carbon steel, conforming to JIS B 2313, JIS B 2313, and JIS G 3456.

Flanges (DN50 through DN80): 17.2 megapascal, forged carbon steel, welding neck with raised face and concentric serrated finish, conforming to JIS G 3201 and JIS G 3202.

Gaskets: Spiral-wound, non-asbestos-filled, carbon steel, with centering provisions, conforming to MLIT-M.
Bolting: Alloy steel bolt studs conforming to JIS G 4107 and JIS G 4303, and semifinished heavy hex-nuts, conforming to JIS G 4051, JIS G 4303 and JIS G 4053.

2.5 COPPER TUBING

Provide copper tubing and fittings with a JIS H 3300 Class 125 service rating, which for 66 degrees C, the pressure rating is 1207 kPa.

2.5.1 Tube

Use copper tube conforming to JIS H 3300, Type L or M for aboveground tubing, and Type K for buried tubing.

2.5.2 Fittings and End Connections (Solder and Flared Joints)

Wrought copper and bronze solder joint pressure fittings, including unions and flanges, shall conform to JIS H 3401. Provide adapters as required. Cast copper alloy solder joint pressure fittings, including unions and flanges, shall conform to JIS H 3401. Cast copper alloy fittings for flared copper tube shall conform to JIS H 3401 and JIS H 5120. JIS H 3300 copper pipe nipples with threaded end connections shall conform to JIS H 3300.

Copper tubing of sizes larger than 100 mm shall have brazed joints. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

Extracted brazed tee joints may be used if produced with an acceptable tool and installed in accordance with tool manufacturer's written procedures.

2.5.3 Grooved Mechanical Connections For Copper

Rigid grooved mechanical connections may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 110 degrees C. Flexible grooved connections shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein.

Each grooved mechanical joint shall be a system, including coupling housing, gasket, fasteners, all furnished by the same manufacturer. Joint installation shall be in compliance with joint manufacturer's written instructions.

Grooved fitting and mechanical coupling housing shall be ductile iron conforming to JIS G 5502. Provide gaskets for use in grooved joints shall be constructed of molded synthetic polymer of pressure responsive design and shall conform to MLIT-M for circulating medium up to 110 degrees C. Provide grooved joints in conformance with MLIT-M.

2.5.4 Solder

Provide solder in conformance with JIS Z 3284-1, grade Sb5, tin-antimony alloy. Solder flux shall be liquid or paste form, non-corrosive and conform to JIS Z 3197.
2.5.5 Brazing Filler Metal

Filler metal shall conform to JIS Z 3202, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.6 VALVES

Provide valves with a Japanese standard service rating.

Valves in sizes larger than 25 mm and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be furnished by the same manufacturer as the grooved pipe joint and fitting system.

2.6.1 Gate Valve

Gate valves 65 mm and smaller shall conform to JIS B 2011 Class 125 and shall be bronze with wedge disc, rising stem and threaded, soldered, or flanged ends. Gate valves 80 mm and larger shall conform to JIS B 2031, Class 125, cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.6.2 Globe and Angle Valve

Globe and angle valves 65 mm and smaller shall conform to JIS B 2011, Class 125. Globe and angle valves 80 mm and larger shall conform to JIS B 2031, Class 125.

2.6.3 Check Valve

Check valves 65 mm and smaller shall conform to JIS B 2011. Check valves 80 mm and larger shall conform to JIS B 2031, Class 125.

2.6.4 Butterfly Valve

Butterfly valves shall conform to JIS B 2032 and JIS B 2011, Type 1 and shall be either the wafer or lug type. Valves smaller than 200 mm shall have throttling handles with a minimum of [two][seven] locking positions. Valves 200 mm and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators.

2.6.5 Plug Valve

Plug valves 50 mm and larger shall conform to JIS B 2031, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 50 mm and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. [Valve shall a weatherproof operators with mechanical position indicators.] Valves 200 mm or larger shall be provided with manual gear operators with position indicators.
2.6.6 Ball Valve

Full port design. Ball valves 15 mm and larger shall conform to JV-5 and shall be cast iron or bronze with threaded, soldered, or flanged ends. Valves 200 mm or larger shall be provided with manual gear operators with position indicators. Ball valves may be provided in lieu of gate valves.

2.6.7 Square Head Cocks

Provide copper alloy or cast-iron body with copper alloy plugs, suitable for 125 psig water working pressure.

2.6.8 Calibrated Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the liters per second flow for each differential pressure reading. [In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.]

2.6.9 Automatic Flow Control Valves

Valve shall automatically maintain the constant flow indicated on the design drawings. Valve shall modulate by sensing the pressure differential across the valve body. Valve shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Provide valve that controls the flow within 5 percent of the tag rating. Valve materials shall be the same as specified for the ball or plug valves.

Provide valve that are [electric][ or ][pneumatic] type as indicated. Valve shall be capable of positive shutoff against the system pump head, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the operating pressure specified. Provide the meter complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.

2.6.10 Pump Discharge Valve

Valve shall shall perform the functions of a nonslam check valve, a manual balancing valve, and a shutoff. Valve shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories. Provide an integral pointer on the valve which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow. Valves smaller than 50 mm shall have NPT connections. Valves 50 mm and larger shall have flanged or grooved end
connections. Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure.

2.6.11 Water Temperature Mixing Valve

Provide water temperature mixing valve that meets performance standards (PSCP) of the water supply Law.

2.6.12 Water Temperature Regulating Valves

Provide copper alloy body, direct acting, pilot operated, for the intended service.

2.6.13 Water Pressure Reducing Valve

Valve, JIS B 8410 for water service, copper alloy body.

2.6.14 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup. Valve, JIS B 8414 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

2.6.15 Combination Pressure and Temperature Relief Valves

JIS B 8414, copper alloy body, automatic re-seating, test lever, and discharge capacity based on AGA temperature steam rating.

2.6.16 Float Valve

[Angle pattern] [Globe pattern]. Valve bodies 80 mm nominal pipe size and smaller shall be bronze. Valve bodies larger than 80 mm shall be cast iron or bronze. Steel parts shall be corrosion resistant. Where float rods are extended for tank applications, extension shall be properly supported and guided to avoid bending of float rod or stressing of valve pilot linkage.

2.6.17 Drain Valves

Valves, JIS B 2011 gate valves. Valve shall be manually-operated, 20 mm pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter. [Freeze-proof type valves shall be provided in installations exposed to freezing temperatures.]

2.6.18 Air Venting Valves

[Automatic type air venting shall be the ball-float type with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat.] Air venting valves on water coils shall have not less than 3 mm threaded end connections. Air venting valves on water mains shall have not less than 20 mm threaded end connections. Air venting valves on all other applications shall have not less than 15 mm threaded end connections.

2.6.19 Vacuum Relief Valves

JIS B 8414
2.7 PIPING ACCESSORIES

2.7.1 Strainer

Strainer, MLIT-M, except as modified and supplemented in this specification. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. Provide blowoff outlet with pipe nipple, gate valve, and discharge pipe nipple. The bodies shall have arrows clearly cast on the sides indicating the direction of flow.

Provide strainer with removable cover and sediment screen. The screen shall be made of minimum 0.8 mm [corrosion-resistant steel,] with small perforations numbering not less than 60 per square centimeter to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.7.2 Combination Strainer and Pump Suction Diffuser

Angle type body with removable strainer basket and internal straightening vanes, a suction pipe support, and a blowdown outlet and plug. Strainer shall be in accordance with MLIT-M, except as modified and supplemented by this specification. Unit body shall have arrows clearly cast on the sides indicating the direction of flow.

Strainer screen shall be made of minimum 0.8 mm [corrosion-resistant steel,] with small perforations numbering not less than 60 per square centimeter to provide a net free area through the basket of at least 3.30 times that of the entering pipe. Flow shall be into the screen and out through the perforations. Provide an auxiliary disposable fine mesh strainer which shall be removed 30 days after start-up. Provide warning tag for operator indicating scheduled date for removal.

Casing shall have connection sizes to match pump suction and pipe sizes, and be provided with adjustable support foot or support foot boss to relieve piping strains at pump suction. Provide unit casing with blowdown port and plug. Provide a magnetic insert to remove debris from system.

2.7.3 Flexible Pipe Connectors

Provide flexible bronze or stainless steel piping connectors with single braid. Equip flanged assemblies with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

2.7.4 Pressure and Vacuum Gauges

Gauges, JIS B 7505-1 with throttling type needle valve or a pulsation dampener and shut-off valve. Provide gauges with 115 mm dial, brass or aluminum case, bronze tube, and siphon. Gauge shall have a range from 0 kPa to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
2.7.5 Temperature Gauges

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Celsius scale in 1 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 1.5 m of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 1.5 to 2.1 m above the finished floor or in locations indicated. Remote element type temperature gauges shall be provided in thermal wells located 2.1 m above the finished floor or in locations indicated.

2.7.5.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 229 mm long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.7.5.2 Bimetallic Dial

Bimetallic dial type case shall be not less than 89 mm stainless steel, and shall be hermetically sealed with clear acrylic lens. Bimetallic element shall be silicone dampened and unit fitted with external calibrator adjustment.

2.7.5.3 Liquid-, Solid-, and Vapor-Filled Dial

Liquid-, solid-, and vapor-filled dial type cases shall be not less than 89 mm, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.7.5.4 Thermal Well

Thermal well shall be identical size, 15 or 20 mm NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 15 mm NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 25 mm.

2.7.6 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports shall be in accordance with MLIT-M.

2.7.7 Escutcheons

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Secure plates in place by internal spring tension or set screws. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.
2.7.8 Expansion Joints

2.7.8.1 Slip-Tube Type

Slip-tube expansion joints, SHASE-S003. Joints shall be provided with internally-externally alignment guides, injected semi-plastic packing, and service outlets. End connections shall be flanged or beveled for welding as indicated. Initial settings shall be made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer.

2.7.8.2 Flexible Ball Type

Flexible ball expansion joints shall be capable of 360 degrees rotation plus 15 degrees angular flex movement. Joints shall be constructed of carbon steel with the exterior spherical surface of carbon steel balls plated with a minimum 0.12 mm of hard chrome in accordance with MLIT-M. Joint end connections shall be threaded for piping 50 mm or smaller. Joint end connections larger than 50 mm shall be grooved, flanged, or beveled for welding. Provide joint with pressure-molded composition gaskets suitable for continuous operation at twice design temperature.

2.7.8.3 Bellows Type

Bellows expansion type joints, JIS B 2352 with Type 304 stainless steel corrugated bellows, reinforced with equalizing rings, internal sleeves, and external protective covers. Joint end connections shall be grooved, flanged, or beveled for welding. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint.

2.8 PUMPS

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to JIS B 8308 and JIS B 8301. Pumps shall be selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to JIS C 4212, be [open] [splash-proof] [totally enclosed], and have sufficient wattage for the service required. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 3,600 rpm, except where the pump head is less than 180 kPa, the pump speed shall not exceed 1,750 rpm. Pump motor shall be equipped with an across-the-line magnetic controller in a industrial use, dust tight enclosure with "START-STOP" switch in the cover.

2.8.1 Construction

Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 862 kPa. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Provide threaded suction and discharge pressure gage tapping with square-head plugs.

Impeller shall be statically and dynamically balanced. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve
type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

[Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings. Pump shall be provided with steel shaft coupling guard. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface.] [Close-coupled pump shall be provided with integrally cast or fabricated steel feet with bolt holes for securing feet to supporting surface. Close-coupled pumps shall be provided with drip pockets and tapped openings.] Pump shall be accessible for servicing without disturbing piping connections. Shaft seals shall be mechanical-seals.

2.8.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone particle separator in line.

2.9 EXPANSION TANKS

Tank shall be welded steel, constructed for, and tested to pressure-temperature rating of 862 kPa at 66 degrees C. Provide tanks precharged to the minimum operating pressure. Tank shall have a replaceable polypropylene or butyl lined diaphragm which keeps the air charge separated from the water; shall be the captive air type.

Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.10 AIR SEPARATOR TANKS

Design to separate air from water and to direct released air to automatic air vent. Unit shall be of one piece cast-iron construction with internal baffles and two air chambers at top of unit; one air chamber shall have outlet to expansion tank and other air chamber shall be provided with automatic air release device. Tank shall be steel, constructed for, and tested to a construction code of pressure vessel (CCPV) pressure-temperature rating.

2.11 WATER TREATMENT SYSTEMS

When water treatment is specified, the use of chemical-treatment products containing equivalent chromium (CPR) is prohibited.

2.11.1 Water Analysis

Conditions of make-up water to be supplied to the condenser and chilled
water systems were reported in accordance with JIS K 0102 and JIS Z 8802 and are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>Date of Sample</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>Conductivity</td>
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2.11.2 Chilled and Condenser Water

Water to be used in the chilled and condenser water systems shall be treated to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required local and base environmental regulations for the treatment of evaporator coils and direct discharge to the sanitary sewer.
2.11.3 Glycol Solution

A [_____] percent concentration by volume of industrial grade [ethylene] [propylene] glycol shall be provided in the chilled water. The glycol shall be tested in accordance with JIS K 2234 with less than 0.013 mm penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

2.11.4 Water Treatment Services

The services of a company regularly engaged in the treatment of [condenser and chilled] water systems shall be used to determine the correct chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company shall maintain the chemical treatment and provide all chemicals required for the [condenser] [condenser and chilled] water systems for a period of 1 year from the date of occupancy. The chemical treatment and services provided over the 1 year period shall meet the requirements of this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Acid treatment and proprietary chemicals shall not be used.

2.11.5 Chilled Water System

A shot feeder shall be provided on the chilled water piping as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.11.6 Condenser Water

The water treatment system shall be capable of [automatically] [continuously] feeding chemicals and bleeding the system to prevent corrosion, scale, and biological formations. [Automatic chemical feed systems shall automatically feed chemicals into the condenser water based on varying system conditions.] [Continuous chemical feed systems shall continuously feed chemicals into the condenser water at a constant rate. The system shall be initially set manually based on the water analysis of the make-up water.]

2.11.6.1 Chemical Feed Pump

One pump shall be provided for each chemical feed tank. The chemical feed pumps shall be positive displacement diaphragm type. The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge.

2.11.6.2 Tanks

Two chemical tanks shall be provided. The tanks shall be constructed of [high density polyethylene] [stainless steel] with a hinged cover. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation. A level indicating device shall be included with each tank. An electric agitator shall be provided for each tank.
2.11.6.3 Injection Assembly

An injection assembly shall be provided at each chemical injection point along the condenser water piping as indicated. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the condenser water piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the condenser water line.

2.11.6.4 Water Meter

Water meters shall be provided with an electric contacting register and remote accumulative counter. The meter shall be installed within the make-up water line, as indicated.

2.11.6.5 Timers

Timers shall be of the automatic reset, adjustable type, and electrically operated. The timers shall be suitable for a 120 volt current of available voltage. The timers shall be located within the water treatment control panel.

2.11.6.6 Water Treatment Control Panel

The control panel shall be a industrial use, drip tight, dust tight enclosure suitable for surface mounting. The panel shall be constructed of stainless steel or steel with a hinged door and lock. The panel shall contain a laminated plastic nameplate identifying each of the following functions:

1. Main power switch and indicating light
2. MAN-OFF-AUTO selector switch
3. Indicating lamp for bleed-off valve
4. Indicating lamp for each chemical feed pump
5. Set point reading for each timer

2.11.6.7 Chemical Piping

The piping and fittings shall be constructed of [schedule 80 PVC] [stainless steel] suitable for the water treatment chemicals.

2.11.6.8 Sequence of Operation

[The chemicals shall be added based upon sensing the make-up water flow rate and activating appropriate timers. A separate timer shall be provided for each chemical. The blow down shall be controlled based upon the make-up water flow rate and a separate timer.] [The system shall contain an adjustable valve for continuous blow down. The flow rate from the appropriate chemical tanks shall be manually set at the metering pump for continuous chemical feed.] The injection of the chemical required for biological control shall be controlled by a timer which can be manually set for proper chemical feed. Timer set points, blow down rates, and chemical pump flow rates shall be determined and set by the water treatment company.

2.11.6.9 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.
2.11.6.10 Bleed Line

A bleed line with a flow valve of the needle-valve type sized for the flow requirement or fixed orifice shall be provided in the pump return to the tower. The bleed line shall be extended to the nearest drain for continuous discharge.

2.12 ELECTRICAL WORK

Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with JIS C 4212.

Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212. Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

[Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Use solid-state variable-speed controllers for motors rated 7.45 kW or less and adjustable frequency drives for larger motors.] [Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.]

2.13 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

2.13.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided. The factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be in accordance with JIS Z 2371, and for that
test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of 3 mm on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system shall be designed for the temperature service.

2.13.2 Shop Painting Systems for Metal Surfaces

Shop painting for metal surface shall be in accordance with MLIT-M.

2.14 FACTORY APPLIED INSULATION

Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 25 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E84.

Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke develop.

2.15 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life and made of [anodized aluminum][stainless steel][______]. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.16 RELATED COMPONENTS/SERVICES

2.16.1 Drain and Make-Up Water Piping

Requirements for drain and make-up water piping and backflow preventer is specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.16.2 Cathodic Protection

Requirements for cathodic protection systems is specified in [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES][and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMMERSSED CURRENT)][Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT].
2.16.3 Field Applied Insulation

Requirements for field applied insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.16.4 Field Applied Insulation

Requirements for field installed insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as supplemented and modified by this specification section.

2.16.5 Field Painting

Requirements for painting of surfaces not otherwise specified, and finish painting of items only primed at the factory, are specified in Section 09 90 00 PAINTS AND COATINGS.

2.16.5.1 Color Coding

Requirements for color coding for piping identification are specified in Section 09 90 00 PAINTS AND COATINGS.

2.16.5.2 Color Coding For Hidden Piping

A color coding scheme for locating hidden piping shall be in accordance with [Section 22 00 00 PLUMBING, GENERAL PURPOSE] [Section 22 00 70 PLUMBING, HEALTHCARE FACILITIES].

PART 3 EXECUTION

3.1 INSTALLATION

Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without written approval. Cut pipe or tubing square, remove burrs by reaming, and fashion to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.1 Welding

Provide welding work specified this section for piping systems in conformance with JIS B 2301, as modified and supplemented by this specification section and the accompanying drawings. The welding work includes: qualification of welding procedures, welders, welding operators, brazers, brazing operators, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

3.1.1.1 Employer's Record Documents (For Welding)

Submit for review and approval the following documentation. This
documentation and the subject qualifications shall be in compliance with JIS Z 3801.

a. List of qualified welding procedures that is proposed to be used to provide the work specified in this specification section.

b. List of qualified welders, brazers, welding operators, and brazing operators that are proposed to be used to provide the work specified in this specification section.

c. List of qualified weld examination personnel that are proposed to be used to provide the work specified in this specification section.

3.1.1.2 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedures specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in JIS B 8285 or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit a list of qualified welders, together with data and certification that each individual is performance qualified as specified. Do not start welding work prior to submitting welder, and welding operator qualifications. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

3.1.1.3 Examination of Piping Welds

Conduct non-destructive examinations (NDE) on piping welds and brazing and verify the work meets the acceptance criteria specified in JIS Z 3801. NDE on piping welds covered by JIS B 2301 is visual inspection only. Submit a piping welds NDE report meeting the requirements specified in JIS B 2301.

3.1.1.4 Welding Safety

Welding and cutting safety requirements shall be in accordance with JIS Z 3422-1 and JIS B 6801.

3.1.2 Directional Changes

Make changes in direction with fittings, except that bending of pipe 100 mm and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.

3.1.3 Functional Requirements

Pitch horizontal supply mains down in the direction of flow as indicated. The grade shall not be less than 2 mm in 1 m. Reducing fittings shall be used for changes in pipe sizes. Cap or plug open ends of pipelines and equipment during installation to keep dirt or other foreign materials out of the system.
Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 65 mm or less in diameter, and with flanges for pipe 80 mm and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges.

Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

3.1.4 Fittings and End Connections

3.1.4.1 Threaded Connections

Threaded connecting shall be in accordance with MLIT-M.

3.1.4.2 Brazed Connections

Brazing, MLIT-M, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.4.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to JIS Z 3801. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with JIS G 3106 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.4.4 Grooved Mechanical Connections

Prepare grooves in accordance with the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.
3.1.4.5 Flared Connections

When flared connections are used, a suitable lubricant shall be used between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

3.1.4.6 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

3.1.5 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.6 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.1.9 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at each heat exchanger, on condenser water piping entering and leaving a condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 25 mm.

3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MLIT-M, except as supplemented and modified in this specification section. Hangers used to support piping 50 mm and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping
subjected to vertical movement, when operating temperatures exceed ambient
temperatures, shall be supported by variable spring hangers and supports or
by constant support hangers.

3.1.10.1 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in equivalent
Japanese Standard and a support shall be installed not over 300 mm from the
pipe fitting joint at each change in direction of the piping. Pipe
supports shall be spaced not over 1.5 m apart at valves. Pipe hanger loads
suspended from steel joist with hanger loads between panel points in excess
of 23 kg shall have the excess hanger loads suspended from panel points.

3.1.10.2 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade,
and at intervals of not more than 4.5 m, not more than 2.4 m from end of
risers, and at vent terminations.

3.1.10.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or
clamp shall be used where each pipe crosses the base support member.
Spacing of the base support members shall not exceed the hanger and support
spacing required for an individual pipe in the multiple pipe run.

3.1.10.4 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic
loads as specified under Sections 13 48 00 [SEISMIC] BRACING FOR
MISCELLANEOUS EQUIPMENT and 23 05 48.19 [SEISMIC] BRACING FOR HVAC [as
shown on the drawings.] Structural steel required for reinforcement to
properly support piping, headers, and equipment but not shown shall be
provided under this section. Material used for support shall be as
specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.10.5 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in
concrete inserts, built-in anchors, or masonry anchor devices. Inserts and
anchors shall be applied with a safety factor not less than 5. Supports
shall not be attached to metal decking. Supports shall not be attached to
the underside of concrete filled floors or concrete roof decks unless
approved by the Contracting Officer. Masonry anchors for overhead
applications shall be constructed of ferrous materials only. Structural
steel brackets required to support piping, headers, and equipment, but not
shown, shall be provided under this section. Material used for support
shall be as specified under Section 05 12 00 STRUCTURAL STEEL.

3.1.11 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion
loops, offsets, and bends and as recommended by the manufacturer for
expansion joints, not to exceed 1.5 m on each side of each expansion joint,
and in lines 100 mm or smaller not more than 600 mm on each side of the
joint.
3.1.12 Pipe Anchors

Anchors shall be provided where indicated. Unless indicated otherwise, anchors shall comply with the requirements specified. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required.

Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal.

3.1.13 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Except as indicated otherwise piping sleeves shall comply with requirements specified. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to JIS G 3302. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to JIS G 3454 and JIS B 2301, [Schedule 30][Schedule 20][Standard weight]. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 13 mm depth. Sleeves shall not be installed in structural members.

3.1.13.1 Refrigerated Space

Refrigerated space building surface penetrations shall be fitted with sleeves fabricated from hand-lay-up or helically wound, fibrous glass reinforced polyester or epoxy resin with a minimum thickness equal to equivalent size Schedule 40 steel pipe. Sleeves shall be constructed with integral collar or cold side shall be fitted with a bonded slip-on flange or extended collar.

In the case of masonry penetrations where sleeve is not cast-in, voids shall be filled with latex mixed mortar cast to shape of sleeve and flange/external collar type sleeve shall be assembled with butyl elastomer vapor barrier sealant through penetration to cold side surface vapor barrier overlap and fastened to surface with masonry anchors.

Integral cast-in collar type sleeve shall be flashed [as indicated.] [with not less than 100 mm of cold side vapor barrier overlap of sleeve surface.] Normally noninsulated penetrating round surfaces shall be sealed to sleeve bore with mechanically expandable seals in vapor tight manner and remaining warm and cold side sleeve depth shall be insulated with not less than [100][_____]mm of foamed-in-place rigid polyurethane or foamed-in-place silicone elastomer.

Vapor barrier sealant shall be applied to finish warm side insulation surface. Warm side of penetrating surface shall be insulated beyond vapor barrier sealed sleeve insulation for a distance which prevents condensation. Wires in refrigerated space surface penetrating conduit shall be sealed with vapor barrier plugs or compound to prevent moisture migration through conduit and condensation therein.
3.1.13.2 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 6.35 mm all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07 92 00 JOINT SEALANTS.

3.1.13.3 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a 5.17 kg/sq. m copper sleeve, or a 0.81 mm thick aluminum sleeve, each within an integral skirt or flange.

Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 200 mm from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 50 mm above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by either one of the following methods.

a. Waterproofing Clamping Flange: Pipes up to and including 250 mm in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

b. Modular Mechanical Type Sealing Assembly: In lieu of a waterproofing clamping flange, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut.

After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals shall provide sleeves of the proper diameters.

3.1.13.4 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07 84 00 FIRESTOPPING.
3.1.13.5 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.14 Access Panels

Access panels shall be provided where indicated for all concealed valves, vents, controls, and additionally for items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in [Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS].

3.2 ELECTRICAL INSTALLATION

Install electrical equipment in accordance with NFPA 70 and manufacturers instructions.

3.3 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.4 FIELD TESTS

Field tests shall be conducted in the presence of the QC Manager or his designated representative to verify systems compliance with specifications. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor.

3.4.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the tests shall be properly isolated.

3.4.2 Pressure Tests

Each piping system shall be hydrostatically tested at a pressure not less than 1297 kPa (gage) for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a currently calibrated test pressure gauge. Leaks shall be repaired and piping retested until test requirements are met. No leakage or reduction in gage pressure shall be allowed.

Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping.
shall be tested in place before concealing.

Submit for approval pressure tests reports covering the above specified piping pressure tests; describe the systems tested, test results, defects found and repaired, and signature of the pressure tests' director. Obtain approval from the QC Manager before concealing piping or applying insulation to tested and accepted piping.

### 3.4.3 Condenser Water Quality Test Reports

The condenser water system shall be analyzed by the water treatment company a minimum of once a month for a period of one year after system acceptance. Submit for approval the specified condenser water quality test reports. The analysis and resulting reports shall include the following information recorded in accordance with JIS K 0102.

| Date of Sample | [_____] |
| Temperature | [_____] degrees C |
| Silica (Sino 2) | [_____] pp (mg/l) |
| Insoluble | [_____] pp (mg/l) |
| Iron and Aluminum Oxides | [_____] pp (mg/l) |
| Calcium (Ca) | [_____] pp (mg/l) |
| Magnesium (Mg) | [_____] pp (mg/l) |
| Sodium and Potassium (Nan and AK) | [_____] pp (mg/l) |
| Carbonate (HO 3) | [_____] pp (mg/l) |
| Sulfate (SO 4) | [_____] pp (mg/l) |
| Chloride (JCL) | [_____] pp (mg/l) |
| Nitrate (NO 3) | [_____] pp (mg/l) |
| Turbidity | [_____] unit |
| pH | [_____] |
| Residual Chlorine | [_____] ppm (mg/l) |
| Total Alkalinity | [_____] epm (meq/l) |
| Non-Carbonate Hardness | [_____] epm (meq/l) |
| Total Hardness | [_____] epm (meq/l) |
| Dissolved Solids | [_____] ppm (mg/l) |
3.4.4 Related Field Inspections and Testing

3.4.4.1 Piping Welds

Examination of Piping Welds is specified in the paragraph EXAMINATION OF PIPING WELDS (above).

3.4.4.2 HVAC TAB

Requirements for testing, adjusting, and balancing (TAB) of HVAC water piping, and associated equipment is specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Coordinate with the TAB team, and provide support personnel and equipment as specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC to assist TAB team to meet the TAB work requirements.

3.5 INSTRUCTION TO GOVERNMENT PERSONNEL

Furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the [chilled water,] [chilled-hot water,][ and][ condenser water piping system[s]]. Instructors shall be thoroughly familiar with all parts of the installation and shall be instructed in operating theory as well as practical operation and maintenance work. Submit a lesson plan for the instruction course for approval. The lesson plan and instruction course shall be based on the approved operation and maintenance data and maintenance manuals.

Conduct a training course for the operating staff and maintenance staff selected by the Contracting Officer. Give the instruction during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be [one man-day.][[_____]][[_____] continuous man-days]. Use approximately half of the time for classroom instruction and the other time for instruction at the location of equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

3.6 ONE-YEAR INSPECTION REPORT FOR COOLING WATER

At the conclusion of the one year period, each connecting [cooling tower] [and] [liquid chiller condenser] inspect for problems due to corrosion, scale, and biological growth. If the equipment is found not to conform to the manufacturers recommended conditions, and the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

-- End of Section --
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 65 00

COOLING TOWERS AND REMOTE EVAPORATIVELY-COOLED CONDENSERS

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

- JIS C 4203 (2010) Single Phase Induction Motors for General Purpose (Amendment 1)
- JIS C 4212 (2010) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)
- JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip
- JIS K 7013 (2009) Fibre Reinforced Plastic Pipes (Amendment 1)

MLIT MECHANICAL STANDARD SPECIFICATION


1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- SD-03 Product Data
  - Cooling Towers; G[, [_____]]
Remote Evaporatively-Cooled Condensers

[ Packaged Cooling Tower - Field Acceptance Test Plan; G[], [_____]]
][ Field-Erected Cooling Tower - Field Acceptance Test Plan; G[], [_____]]
][ Packaged Cooling Tower - Field Acceptance Test Report; G[], [_____]]
][ Field-Erected Cooling Tower - Field Acceptance Test Report; G[], [_____]]

SD-07 Certificates

Cooling Tower
Remote Evaporatively-Cooled Condensers

SD-10 Operation and Maintenance Data
Operation and Maintenance Manuals
Remote Evaporatively-Cooled Condensers

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with Occupational Safety and Health Act Enforcement Regulations (Roudou-Anzen-Eiseihou-Sekou-kisoku) for Japanese Standard. [[Catwalk,] [ladder,] [and guardrail] must be provided where indicated and in accordance with[ Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][ Section 05 51 33 METAL LADDERS][ Section 05 52 00 METAL RAILINGS][ Section 05 51 00 METAL STAIRS].]

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items must be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings must be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate
all offsets, fittings, and accessories that may be required. The Contractor must carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and must arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment must be standard commercial catalogued products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use in field service for two years prior to bid opening. The two year use must include applications of equipment and materials under similar circumstances and of similar size. Products having less than a two year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. This 6000 hour record must not include any manufacturer's prototype or factory testing. Records of satisfactory field use must be completed by a product that had been, and presently is, sold, or offered for sale on a commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures. Products must be supported by a service organization located in Japan. System components must be environmentally suitable for the indicated locations.

2.2 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including cooling towers, cooling tower gear drive assemblies, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life. Plates must be fixed in prominent locations.

2.3 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, must be provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with JIS C 4203.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212.

d. Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the
nameplate rating of the motor. Motors must be rated for continuous
duty with the enclosure specified. Motor duty requirements must allow
for maximum frequency start-stop operation and minimum encountered
interval between start and stop. Motor torque must be capable of
accelerating the connected load within 20 seconds with 80 percent of
the rated voltage maintained at motor terminals during one starting
period. Provide motor starters complete with thermal overload
protection and other necessary appurtenances. [Motor bearings must be
fitted with grease supply fittings and grease relief to outside of the
enclosure.] Motor enclosure type may be either TEAO or TEFC.

e. [Where two-speed motors are indicated, variable-speed controllers may
be provided to accomplish the same function.][ Use adjustable
frequency drives for all variable-speed motor applications.] Provide
variable frequency drives for motors as specified in Section 26 29 23
VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.

f. Provide inverter duty premium efficiency motors for use with variable
frequency drives.

2.4 COOLING TOWER MATERIALS

2.4.1 Fiberglass Reinforced Plastic (FRP)
FRP components must be inert, corrosion resistant, and fire-retardant with
a thickness of 3.66 kg per square meter. FRP components must contain an
ultraviolet (UV) ray inhibitor. Components manufactured of polystyrene
will not be permitted.

2.4.2 Zinc-Coated Steel
Components fabricated of zinc-coated steel must be not lighter than 16 gauge
1.613 mm steel, protected against corrosion by a zinc coating. The zinc
coating must conform to JIS G 3302, as applicable and have an extra heavy
coating of not less than 760g per square meter of surface. Galvanized
surfaces damaged due to welding must be coated with zinc rich coating.

2.4.3 High Density Polyethylene (HDPE)
Components manufactured from HDPE must be seamless with a minimum thickness
of 10 mm. The material must have the appropriate inhibitors to protect the
component from any UV degradation. Tanks and cooling tower shells must be
seamlessly molded to minimize water loss/consumption.

2.4.4 Stainless Steel Sheets
Type [304][316].

2.4.5 Concrete
Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE. Exposed
concrete must be rub-finished for smooth and uniform surfaces free of form
marks and defects. Honeycomb concrete will not be permitted.

2.4.6 Hardware
Bolts must be cadmium-plated, zinc-coated steel, or Type 304 stainless
steel. Each bolt must be provided with neoprene and cadmium-plated steel
washers under the heads. Nails must be silicon bronze, commercial bronze,
or stainless steel. Hardware must meet the salt-spray fog test as defined by JIS Z 2371. Angle brackets and similar parts must be zinc-coated steel. Zinc coatings must conform to JIS H 8641 and JIS H 8641, as applicable, and must have an extra heavy coating of not less than 760g per square meter of surface. Nails must be silicon bronze, commercial bronze, or stainless steel. Subject hardware to a salt-spray fog test in accordance with JIS Z 2371. No signs of corrosion must be evident after continuous exposure to a salt spray.

2.5 COOLING TOWERS

2.5.1 Factory Assembled Towers

2.5.1.1 Description

The cooling tower must be of the [induced mechanical draft] or forced mechanical draft type. The cooling tower must include frames and casings, louvers, drift eliminators, partitions, windbreak baffles, drift-check walls, cold water basin equipment, fans and fan walls, blowers, drives, electric motors, access doors, [working platforms,] inspection plates, and panels.

2.5.1.2 Construction

Tower must be constructed to withstand a wind pressure of not less than 1.44 kilopascal (kPa) on any external surface. Fan deck must be constructed to withstand a live load of not less than 2.87 kPa in addition to the concentrated or distributed loads of equipment mounted on the fan deck.

The hot water distribution system must be of the open basin gravity feed type or the pressurized spray header type design.

2.5.1.3 Tower Frame and Louvers

Provide frame constructed from [galvanized steel]. Intermediate structural members must be provided for rigidity and support of casings, louvers, fill, distribution systems, fan decks, and other equipment. Inlet air louvers must permit free air passage but no splashout, and must be designed to prevent debris and sunlight from entering the cold water basin.

2.5.1.4 Air Inlet And Discharge Connections

On forced draft centrifugal type units, the air inlet and discharge connections must have flanged or lipped projections for connecting to ductwork.

2.5.1.5 Fill

The fill must support expected loads without sag or failure and arranged to effectively break up the water. The fill must be manufactured and performance tested by the cooling tower manufacturer. The fill must be of the materials as specified. Polyvinyl chloride (PVC) fill is suitable for inlet temperatures to 51.7 degrees C on cross flow type units and temperatures to 54.4 degrees C on counterflow type units. Chlorinated polyvinyl chloride (CPVC) fill must be used for applications where inlet temperatures are greater than 54.4 degrees C. Fill must be in accordance with MLIT-M.
2.5.1.6 Drift Eliminators

Provide drift eliminator sections designed and arranged to effectively trap water droplets entrained in the discharge airstream. Sections must be assembled in easily removable sections for forced mechanical drift tower and counterflow induced mechanical draft tower. Drift eliminators must be constructed of Polyvinyl chloride (PVC) in accordance with MLIT-M.

2.5.1.7 Cold Water Basin Equipment.

Include [galvanized steel] [Type 304 stainless steel] sump with stainless steel removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. [Provide float valves with adjustable arms. Valve sizes larger than 13 mm pipe size must be the balanced piston type. Valve seats and disks must be replaceable.] [Electronic water level control must be provided.]

Provide cold water basins and casings suitably sealed and flashed at joints and connections to ensure watertight construction.

2.5.1.7.1 Electric Basin Heater

Heater must be the electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 12.8 degrees C at an ambient temperature of 4.4 degrees C. Heater must be complete with control thermostat, transformer, contactor, and low water level heater protection.

2.5.1.8 Fans, Blowers, and Drives.

The towers must have axial propeller-type fans having not less than four aluminum alloy or glass-reinforced polypropylene blades or squirrel-cage, centrifugal-type blowers, as applicable. Fans and blowers must be designed and constructed to withstand 50 percent overspeed above normal maximum operating speeds.

If belt drives are utilized, multi-grooved solid back single belt design must be used to avoid uneven belt stretch. Adjustment must be provided for belt tension and drive centers. Belt drives must be designed and constructed for 150 percent overload. Sheaves located in the airstream must be corrosion-resistant material. Shafting for gear drives must have flexible-type couplings requiring no lubrication. The gear assemblies must be enclosed in an oil filled housing provided with fill and drain plugs.

2.5.1.9 Tower Piping

Piping must be schedule 40 PVC and conform to JIS K 7013. Fittings for other piping materials must be of the same material or equal and of the same class and grade as the pipe.

2.5.1.10 Electric Motors

Requirements are specified in paragraph ELECTRICAL WORK.

2.5.1.11 Vibration Cutout Switch.

Provide electronic vibration cutout switch with auxiliary contacts in a protected position and most effective location, interlocked with the fan wiring to electrically open the motor circuit under excessive fan vibration.
2.5.1.12 Performance

The factory assembled tower must have Cooling Tower Institute certification that the cooling tower will perform thermally at the rating published by the tower manufacturer in his copyrighted literature.

2.5.1.13 Sound Power Level

Sound power levels, in decibels (dB) with a reference pressure of 0.0002 microbars, of the cooling tower must be not greater than the maximum permitted dB levels for the designated octave band as set forth in Table I or Table II. The sound power level data for the cooling tower must have been verified in tests conducted in accordance with JIS Z 8106.

<table>
<thead>
<tr>
<th>Octave Band (Hz)</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
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<td>Sound Power Level (dB)</td>
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<td>112</td>
<td>110</td>
<td>108</td>
<td>102</td>
<td>98</td>
<td>93</td>
<td>90</td>
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<tr>
<th>Octave Band (Hz)</th>
<th>63</th>
<th>125</th>
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<tr>
<td>Sound Power Level (dB)</td>
<td>112</td>
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<td>110</td>
<td>108</td>
<td>102</td>
<td>98</td>
<td>93</td>
<td>90</td>
</tr>
</tbody>
</table>

2.5.1.14 Drift Loss

Drift loss must be not greater than 0.005 percent of the water circulated.

2.5.2 Lubrication

The lubricating points must be extended to the outside of the unit for easy accessibility. Where use of high pressure lubricating equipment, 6894 kPa or higher, will damage grease seals or other parts, a suitable warning must be affixed to the equipment in a conspicuous location.

2.5.3 Factory Finish System

[Factory painting system] must have been proven to withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Equipment located in a sea coast environment must withstand 3,000 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with JIS Z 2371. For salt-spray fog test, the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 3 mm on either side of the scratch mark.
The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system must be designed for the temperature service and must have been proven to pass the specified salt-spray test.

2.5.4 Field-Assembled Cooling Towers

Factory fabricated, factory-assembled towers which are shipped to the job site in separate cells or modules must be provided with all appropriate manufacturer's hardware for assembly in the field. Factory fabricated, field-assembled towers must be assembled and adjusted at the job site by a factory representative.

2.5.4.1 Framework, Casing, and Supports

Towers must be designed and constructed to withstand a wind pressure of not less than [1.4] [_____] kPa on external surfaces. Framework, structural supports, and equipment supports must be [zinc-coated steel,] [Type 304 stainless steel,] [air-entrained concrete] [FRP,] [or] [lumber]. Casing (exterior enclosing walls) must be constructed of [zinc-coated steel,] [Type 304 stainless steel,] [air-entrained concrete] [FRP]. Materials provided for framework, casings and equipment supports must be compatible. Structural supports must be provided in accordance with the recommendations of the manufacturer of the tower unless otherwise indicated.

2.5.4.2 Foundations

Cooling tower foundations must meet the requirements of the cooling tower manufacturer and wind and seismic loads, wind and seismic loads and be as indicated. Foundation design must be based on the load conditions and soil bearing value indicated. Foundation calculations must be submitted with the equipment drawings.

2.5.4.3 Stairways and Ladders

Provide stairs, 60-degree ship ladders or straight-rung ladders of standard design, starting at [ground] [roof] level and extending as high as required to gain access to fan decks and water distribution systems. Stairways and ladders must be hot-dip, zinc-coated steel. Ladders higher than 3.66 meters must have a safety cage.

2.5.4.4 Hand Railings

Steel hand railings must be not less than 1067 mm high around the exterior of each working surface that is 3.66 m or more above the ground, roof, or other supporting construction. Railings must be not smaller than 32 mm zinc-coated steel pipe with standard zinc-coated steel railing.

2.5.4.5 Access Doors

Each tower must be provided with access doors at grade level to provide entry to the interior for service maintenance without removal of the fill. Doors must be provided on each endwall of each cooling tower cell. Frame and brace access doors to prevent damage when opening and closing. Doors must be located adjacent to float controls.
2.5.4.6 Louvers

Air inlets for each cooling tower must be provided with individually removable louvers arranged to prevent the escape of water. Louvers must be constructed of [PVC], [fiberglass reinforced polyester], [zinc-coated steel], [Type 304 stainless steel] [FRP]. Materials provided for casings and louvers must be compatible; one material must not produce stains upon the other. Air intakes must be provided with 25 mm zinc-coated steel mesh.

2.5.4.7 Fan Deck and Cylinder

Each fan must be mounted in a fan cylinder (or stack) to elevate the fan discharge air. Total extension height must not exceed the fan diameter. Each fan cylinder must be provided with a zinc-coated steel, 12 gauge 2.753 mm wire mesh securely mounted to the top of the cylinder in accordance with manufacturer's recommendations. Fan decks must be designed to withstand a live load of not less than [1.9] [2.9] kPa in addition to the concentrated or distributed loads of equipment mounted on the fan decks. [Fan deck and cylinders must be constructed of zinc-coated steel, lumber, Type 304 stainless steel, or FRP and be compatible with the entire tower construction.] [Fan deck must be constructed of precast, reinforced lightweight concrete, in multiple sections, forming a complete, vibration-free base for mounting fan, speed reducer, drive shaft, motor, and fan stacks. Fan cylinders (or stacks) must be constructed of precast, reinforced lightweight concrete in multiple sections, constrained with bands of zinc-coated steel conforming to JIS H 8641, not less than 3 by 75 mm, and bolted to form a compressive load on stack perimeter. Fan cylinder must be secured in place on the fan deck with Class A mortar.]

2.5.4.8 Fans

Fans must be the [centrifugal] [or] [adjustable-pitch propeller] type, constructed of zinc-coated steel, Type 304 stainless steel, aluminum or an aluminum alloy, or FRP. Propeller type fans must have a maximum tip speed of 330 m/minute. Fan blade assembly must be both statically and dynamically balanced after assembly of the cooling tower. Fan hub must be constructed of [zinc-coated steel], [stainless steel], [cast aluminum] with adequate surface protection against corrosion. Complete fan assembly (fan and mounting) must be designed to give maximum fan efficiency and long life when handling saturated air at high velocities. Each cooling tower fan must be provided with a ball and pedestal type vibration limit switch which must stop the corresponding fan motor in the event of sensing excessive fan vibration.

2.5.4.9 Speed Reducers Gears and Drive Shaft

Speed reducer gears must be rated. Reducer must be mounted in accordance with manufacturer's recommendations. Each reducer must be provided with an oil level cutoff switch interlocked to the fan motor. Each reducer must be provided with an oil level sight glass, fill, drain, and vent lines located in a readily accessible position. Drive shafts must be the full floating type with flexible couplings at both ends and have a service factor of 1.0 or greater. Drive shafts must be of stainless steel, fitted each end with flexible couplings (stainless steel plate type). Each drive shaft must be provided with a galvanized steel guard, to prevent damage to surrounding equipment in case of shaft failure. Provision must be made for lubrication of all bearings. Bearings must be accessible to the extent that each bearing can be lubricated without dismantling fan.
2.5.4.10 Electric Motors

Each motor must be a [single speed], [two speed] [variable speed], totally enclosed, insulation JIS C 4212, continuous-rated type which conforms to JIS C 4212. Motors must have [open], [dripproof], [totally enclosed], [explosion proof] enclosures and be located outside the discharge airstream. Motors must be mounted according to manufacturer's recommendations. Motors must be provided specifically for either pump or fan application and must comply with the requirements of paragraph ELECTRICAL WORK.

2.5.4.11 Cold Water Basin

Basin must be completely watertight and constructed of [zinc-coated steel] [Type 304 stainless steel] [FRP]. Basin must be constructed and installed to ensure that air will not be entrained in outlets when operating and no water will overflow on shutdown. Each individual sump must be provided with an individual outlet. Each outlet must be provided with a 13 mm stainless steel wire mesh, securely mounted to prevent trash from entering the outlet. Each basin must be provided with overflow and drain valve connections. Each basin must be provided with a float-controlled, makeup water valve as indicated. The makeup water must discharge not less than 50 mm or two pipe diameters, whichever is greater, above the top of the basin.

2.5.4.12 Electric Basin Heater

Heater must be the electric immersion type with water-tight junction boxes mounted in the basin with sufficient capacity to maintain the basin water temperature above 4.4 degrees C at an ambient temperature of [_____] degrees C. Heater must be complete with control thermostat, transformer, contactor, and low water level heater protection.

2.5.4.13 Hot Water Distribution System

Water distribution must be the [pressurized-flow] type system which distributes waters evenly over the entire fill surface. Each tower cell must be designed so that a water flow of 140 percent capacity will not cause overflowing or splashing. The distribution system for each cell must include adjustable flow control valves. The entire distribution system must be self-draining and nonclogging. Piping must be either cast iron, ductile iron, threaded-glass-fiber reinforced epoxy pipe, polypropylene, PVC or Schedule 80 black steel.

a. Gravity-Flow System: System must be provided with open basins which include a splash box or baffles to minimize splashing of incoming hot water and holes that evenly distribute the water over the entire decking area. Holes used in a water basin must be provided with ceramic or plastic orifice inserts.

b. Pressurized-Flow System: System must include piping, fittings, branches, and spray nozzles. Spray nozzles must be schedule 40 PVC. Nozzles must be cleanable, nonclogging, removable, and spaced for even distribution.

c. Basin Cover: Hot water distribution basins must be provided with the tower manufacturer's standard removable, [zinc-coated galvanized steel] [304 stainless steel] [FRP] covers. Covers must prevent airborne debris from entering the basin.
2.5.5 Drift Eliminators

Eliminators must be provided in the tower outlet to limit drift loss to not over [0.005] percent of the circulating water rate. Eliminators must be constructed of polyvinyl chloride (PVC). Eliminators sections must be supported on PVC or FRP tee sections.

2.5.6 Cold Water Basin Equipment.

Include sump with removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. Provide float valves with adjustable arms. Valve sizes larger than 13 mm pipe size must be the balanced piston type. Valve seats and disks must be replaceable. [Electric water level control must be provided.]

Provide cold water basins and casings suitably sealed and flashed at joints and connections to ensure watertight construction.

2.5.7 Fill (Heat Transfer Surface)

Tower fill must be the [splash] [or] [film] type. Fill material must be free to expand or contract without warping or cracking. No plasticized wood cellulose must be provided for fill material. Fill must be removable or otherwise made accessible for cleaning. Space supports must be corrosion resistant and must prevent warping, sagging, misalignment, or vibration of the fill material. Fill material and supports must be designed to provide for an even mixing of air and water. Fill material must be constructed of [aluminum] [stainless steel] [tile of multi-cell design, set without mortar] [PVC formed sheets, zinc-coated steel] in a pattern, and of sufficient height to meet the performance specifications. [Tile fill must be vitreous, with a low water absorption that will pass a freeze-thaw test conducted. Tile fill must have a minimum crushing strength of 13.8 MPa over the gross area of the tile when the load is applied parallel to the cells. Cast iron tee section lintels supporting the tile fill must conform to JIS G 5501, Class 25, 3.2 mm additional thickness for corrosion. Lintels must be designed with a safety factor of 2 minimum.]

2.5.8 Meters and Controls

Tower must be provided with makeup and blowdown meters, conductivity controller, and overflow alarm.

2.6 REMOTE EVAPORATIVELY-COOLED CONDENSERS

Condenser must include fans, water pump with suction strainer, electric motor and drive equipment, water eliminators if required, condensing coil, liquid receiver if required, water pan or sump, spray nozzles or water-distribution pan, water strainer, water make-up assembly, bleeder with flow valve of the needle valve type sized for the flow required or a fixed orifice, enclosure with suitable access doors, and air-inlet and outlet openings. No water may carry over into the unit discharge outlet.

2.6.1 Condenser Casing

Enclosure must be constructed of not lighter than 18 gauge 1.311 mm[ hot-dip galvanized steel][ 304 stainless steel], reinforced and braced. Access doors or panels suitably sized and located must be provided for access to water nozzles or distribution pan, coils, and valves for...
cleaning, repair, or removal of the item. Access doors or panels must be gasketed with synthetic rubber, or equivalent gasket material, and locked in place with thumb screws or catches. One-half inch mesh hot-dip galvanized steel or copper air-inlet screens must be provided on each air inlet.

2.6.2 Refrigerant Section

Condenser coil must be constructed of unfinned copper or steel tubes hot-dip galvanized after fabrication. A refrigerant charging valve must be installed in the liquid line between the receiver cut-off valve and the expansion device. Refrigerant section must be tested in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for the refrigerant employed in the system. CFC-based refrigerants are prohibited.

2.6.3 Fans

Fans must be centrifugal or propeller type as best suited for the application. Fans must be direct or V-belt driven. Belt drives must be completely enclosed within the unit casing or equipped with a guard. When belt drive is provided, an adjustable sheave to furnish not less than 20 percent fan-speed adjustment must be provided. Sheave set must be matched and selected to provide the capacity indicated at the approximate midpoint of the adjustment. Fans must be statically and dynamically balanced. Fan motor must be totally enclosed type or open drip-proof and located within an enclosure to be fully protected from the weather.

2.6.4 Water Section

Water eliminators must be constructed of nonferrous metal, of an approved nonmetallic material, or of not lighter than 24 gauge 0.701 mm steel, hot-dip galvanized after fabrication. Spray nozzles must be brass non-clogging type designed to permit easy disassembly, and must be arranged for easy access. Water pump must be bronze-fitted centrifugal or turbine type, and may be mounted as an integral part of the evaporative condenser or remotely on a separate mounting pad. Pump suction must be fully submerged and provided with screened inlet. Water pan or sump must be constructed of not lighter than 14 gauge 1.994 mm steel, hot-dip galvanized after fabrication, or molded acid-resistant glass-fiber-reinforced polyester. Water distribution pan must be constructed of not lighter than 16 gauge 1.613 mm steel, hot-dip galvanized after fabrication. Joints must be watertight. Water pan or sump must be provided with drain, overflow, and make-up water connection with stop valve and float valve. A bleed line with a flow valve of the needle type sized for the flow required or fixed orifice must be provided in the pump discharge line and must be extended to the nearest drain for continuous discharge.

2.7 FABRICATION

Equipment and component items, must have been proven to withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Equipment located in a sea coast environment must withstand 3,000 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with JIS Z 2371. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to JIS H 8641.
2.8 SUPPLEMENTAL COMPONENTS/SERVICES

2.8.1 Condenser Water Piping and Accessories

Condenser water piping and accessories must be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT, AND CONDENSER WATER PIPING SYSTEMS.

2.8.2 Cooling Tower Water Treatment Systems

Cooling tower water treatment systems must be provided and installed in accordance with Section 23 64 26 CHILLED, CHILLED-HOT AND CONDENSER WATER PIPING SYSTEMS.

2.8.3 Temperature Controls

Cooling towers must be fully coordinated with and integrated into the temperature control system specified in [Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] into the existing air-conditioning system.

PART 3 EXECUTION

3.1 DEMONSTRATIONS

Contractor must conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total [__8___] hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. The training course must cover all of the items contained in the approved Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

Provide a schedule, at least [2] [_____] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

3.2 INSTALLATION

Installation of cooling tower systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in compliance with the manufacturer's written installation instructions, including the following:

(1) Packaged cooling tower - installation instructions

(2) Field-erected cooling tower - installation instructions

3.2.1 Installation Instructions

Provide manufacturer's standard catalog data, at least [5] [_____] weeks prior to the purchase or installation of a particular component, highlighted to show features such as materials of construction, dimensions, options, performance and efficiency. Data must include manufacturer's recommended installation instructions and procedures. Data must be adequate to demonstrate compliance with contract requirements.
3.2.2 Vibration Isolation

If vibration isolation is specified for a unit, vibration isolator literature must be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

3.2.3 Posted Instructions

Provide posted instructions, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

3.2.4 Verification of Dimensions

Provide a letter including the date the site was visited, conformation of existing conditions, and any discrepancies found.

3.2.5 Demonstrations

Provide a schedule, at least [2] [_____] weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

3.2.6 Certificates

Where the system, components, or equipment are specified to comply with requirements of JIS or other Japanese requirements, proof of such compliance must be provided. The label or listing of the specified agency must be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted.

3.2.7 Operation and Maintenance Manuals

Provide [Six] [_____] complete copies of an operation manual in bound 216 by 279 mm booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least [4] [_____] weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. [Six] [_____] complete copies of maintenance manual in bound 216 by 279 booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.2.8 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into
existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.3 RELATED FIELD TESTING

3.3.1 Test Plans

a. Manufacturer's Test Plans: Within [120] [_____] calendar days after contract award, submit the following plans:

   (1) Packaged cooling tower - field acceptance test plan

   (2) Field-erected cooling tower - field acceptance test plan

   Field acceptance test plans must be developed by the cooling tower manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

   The Contracting Officer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance test plans must be the plan and procedures followed for the field acceptance tests of the cooling towers and subsequent test reporting.

b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of tower system controls which interlock and interface with controls for the equipment provided under [Section 23 09 53.00 20, SPACE TEMPERATURE CONTROL SYSTEMS] [Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][Section 23 09 23.01 LONWORKS DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS] [or] [Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS].

c. Prerequisite testing: Cooling towers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

   Each test plan must include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures must be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

   Controllers must be verified to be properly calibrated and have
the proper set point to provide stable control of their respective equipment.

e. Performance variables: Each test plan must list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Tower manufacturer must furnish with each test procedure a description of acceptable results that have been verified.

Tower manufacturer must identify the acceptable limits or tolerances within which each tested performance variable must acceptably operate.

f. Job specific: Each test plan must be job specific and must address the particular cooling towers and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Each test plan must include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.4 TESTING

a. Each cooling tower system must be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

(1) Packaged cooling tower - field acceptance test report

(2) Field-erected cooling tower - field acceptance test report

b. Manufacturer's recommended testing: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.

c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed must result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.

d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment must be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative must review, approve, and sign
the report of the manufacturer's recommended test. Signatures must be accompanied by the person's name typed.

f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests must be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

g. Towers with thermal performance must have their thermal performance verified by field testing.

-- End of Section --
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 81 00.00 20

UNITARY AIR CONDITIONING EQUIPMENT

11/09

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 8607 (2008) Flare Type and Brazing Type Fittings for Refrigerants


JIS B 8616 (2015) Package Air Conditioners


JIS C 4212 (2010) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)


JIS G 3302 (2019) Hot Dip Zinc Coated Steel Sheet and Strip

JIS H 3300 (2018) Copper and Copper Alloy Seamless Pipes and Tubes

JIS H 3401 (2001) Pipe Fittings of Copper and Copper Alloys
JIS H 8641 (2007) Hot Dip Galvanized Coatings

MLIT MECHANICAL STANDARD SPECIFICATION

JAPAN REFRIGERATION AND AIR CONDITIONING INDUSTRY ASSOCIATION
JRA Standard Japan Refrigeration and Air Conditioning

JAPAN ELECTRICAL MANUFACTURERS ASSOCIATION
JEM 1038 AC Electromagnetic Contactor
JEM 1167 High Voltage Electromagnetic Contactor

1.2 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval or for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Field-Assembled Refrigerant Piping
   Control System Wiring Diagrams

SD-03 Product Data
   Room Air Conditioners
   Packaged Terminal Units
   Heat Pumps, Air to Air
   Air Conditioners

SD-06 Test Reports
   Start-Up and Initial Operational Tests

SD-10 Operation and Maintenance Data
   Room Air Conditioners, Data Package 3
Packaged Terminal Units, Data Package 3
Heat Pumps, Air to Air, Data Package 3
Air Conditioners, Data Package 3
Filters, Data Package 2
Thermostats, Data Package 2

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

1.4.1 Modification of References

Accomplish work in accordance with the referenced publications, except as modified by this section. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to "the Authority having jurisdiction," "the Administrative Authority," "the Owner," or "the Design Engineer" to mean the Contracting Officer.

1.4.2 Detail Drawing

For refrigerant piping, submit piping, including pipe sizes. Submit control system wiring diagrams.

1.4.3 Safety

Design, manufacture, and installation of unitary air conditioning equipment shall conform to Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku).

1.4.4 Posted Operating Instructions

Submit posted operating instructions for each packaged air conditioning unit.

1.4.5 Sizing

Size equipment based on MLIT-M; do not oversize.

1.4.6 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be Refrigerant Handling Technician (Reibai-Furontou-Toriatsukai-Gijutsusha) under Japan Refrigeration and Air-Conditioning Industry Association. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.5 REFRIGERANTS

Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0, with the exception of R-123. CFC-based refrigerants are prohibited.
HCFCs and Halons shall not be permitted.

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain positive pressure within the building. Meet or exceed filter media efficiency as tested in accordance with JIS B 9908-1.

PART 2 PRODUCTS

2.1 ROOM AIR CONDITIONERS

JIS B 8616. Minimum energy efficiency ratio (EER) shall be in accordance with Room Air Conditioners: Provide units removable from inside the building for servicing without removing the outside cabinet. Construct outside cabinets, including metal grilles to protect condenser coils, of zinc-coated steel or aluminum. Steel and zinc-coated surfaces shall receive at least one coat of primer and manufacturer's standard factory-applied finish. Insulate cabinets to prevent condensation and run off of moisture. Provide mounting hardware made of corrosion-resistant material or protected by a corrosion-resistant finish. Provide air filters of the [throw-away] [or] [permanent washable] type removable without the use of tools and arranged to filter both room and ventilating air. Remove condensate by means of a drain or by evaporation and diffusion. Provide with metal or plastic mounting flanges on each side, top, and bottom of unit. For thru-the-wall installations provide aluminum or shop painted zinc-coated steel flanged telescopic wall sleeves. Design wall sleeves to restrict driving rain. For window mounted units provide shop-painted metal mounting brackets, braces, and sill plates. Mount compressors on vibration isolators. Minimum cooling capacity shall be not less than that indicated.

2.1.1 Units for Operation on 100 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15- or 20-amp, 3-pole, 125-volt ground type plug to match receptacle.

2.1.2 Units for Operation on 200 Volts

Provide 3-wire cords of manufacturer's standard length. If not existing, provide a receptacle within reach of the standard length cord. Cords shall have a 15-, 20-, or 30-amp, 3-pole, 250-volt or manufacturer's standard ground type plug to match receptacle.

2.1.3 Controls

Mount controls in cabinet. Manual controls shall permit operation of either the fan or the fan and refrigerating equipment. Fan control shall provide two fan speed settings. Automatic controls shall include a thermostat for controlling air temperature. Thermostat shall have an adjustable range, including 18 to 28 degrees C and shall automatically turn the refrigeration system on or off to maintain the preselected temperature within plus or minus 20 degrees C.

2.2 PACKAGED TERMINAL UNITS

2.2.1 Heat Pumps

JIS B 8616, air-cooled, split type; [Heat pumps shall have a minimum energy
efficiency ratio (EER) of [____], or a minimum Coefficient of Performance (COP) of [____], and a minimum integrated part load value (IPLV) of [___].] [Provide supplemental electric resistance heaters integral with unit.] [Provide units suitable for use with minimal ductwork having a total external static resistance up to 25 Pa.]

2.2.2 Air Conditioners

JIS B 8616, air-cooled, split type. Provide units with [heating only] [cooling only] [combination heating and cooling] section with indicated capacity. Minimum [seasonal] energy efficiency ratio ([S]EER) shall be [____] [S]EER.] [Provide units suitable for use with minimal ductwork having a total external static resistance up to 25 Pa.]

2.2.3 Indoor Noise Rating

Rate in accordance with Japanese manufacture's standard ratings. Indoor rating shall not exceed [____] bels while entire unit is operating at any fan or compressor speed.

2.2.4 Wall Sleeves and Mounts

Provide manufacturer's standard wall sleeves and mounts. Wall sleeves shall have seals designed to restrict driving rain and wind. [Provide unit subbase of the same construction and finish as the sleeve to provide for concealed electrical connection, cord storage, and equipped with unit leveling legs.] [Provide subbase with 24-volt remote control circuitry and wall mounted thermostat.]

2.2.5 Heating Section for Air Conditioners

a. Electric Coils: Electric resistance heating elements with high temperature-limit safety device, factory-mounted, and wired to chassis.

b. Hot Water Coils: Serpentine type constructed of seamless copper tubes with aluminum fins mechanically or hydraulically bonded to tubes. Provide factory-furnished tee and manual air vent on return connection. Factory test coils at twice maximum operating pressure.

c. Steam Coils: Serpentine type constructed of red brass or seamless copper tubes with JIS H 3300 mechanically or hydraulically bonded to tubes. Factory test coils at twice the maximum operating pressure.

d. Heating unit shall have internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84 or shall have non-flammable and non-combustible manufacture's standard insulations.

2.2.6 Refrigeration Sections

Completely self-contained, slide-in assembly or removable chassis with welded, hermetically sealed, air-cooled refrigeration system, outdoor fan, indoor fan, control box, and ventilation damper. Provide refrigeration sections capable of installation or removal without the use of tools. Refrigeration sections shall include refrigeration circuit tubing, wiring, and safety controls, and shall operate down to 2 degrees C outdoor temperature and 21 degrees C indoor temperature, without compressor short cycling while delivering not less than 100 percent of rated cooling capacity. Units shall have drains to the building exterior to eliminate
excess driving rain. Condensate shall not drain onto building exterior or interior.


b. Coils: Constructed of seamless copper or aluminum tubing with copper or aluminum fins bonded to tubes. [Coat outdoor air coils with factory applied corrosion resistant treatment. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

c. Outdoor Fans: Direct connected centrifugal type with aluminum or plastic wheel and forward curved blades or direct connected aluminum propeller type. Design fans so that condensate will evaporate without drip, splash, or spray on building exterior.

d. Indoor Fans: Direct connected centrifugal type with aluminum, galvanized steel, or plastic wheel and forward curved blades. Provide minimum two-speed motor with built-in overload protection.

2.2.7 Ventilation Damper Assembly

Operated by automatic actuator. Dampers shall close on unit shutdown or loss of power and shall open on heating or cooling start-up.

2.2.8 Air Filters

Removable without use of tools, and shall filter both recirculated and ventilating air.

2.2.9 Controls

Provide controls including, an adjustable thermostat, and switches, to regulate room air temperature through control of refrigerant compressors or heating elements. Controls shall at least have positions for off, high or low fan speed for [heating] [and] [cooling], and fan only operation. [Provide remote mounted night set-back thermostat.]

2.3 HEAT PUMPS, AIR TO AIR

Provide factory assembled units complete with accessories, wiring, piping, and controls. Provide units with [outlet grilles.] [supplemental electric heaters.] [humidifiers.] [air filters as specified in the paragraph FILTERS.]

2.3.1 Energy Performance

[Energy performance shall be in accordance with JIS B 8615-1. ][Heat pumps shall have [a minimum [seasonal] energy efficiency ratio ([S]EER) of [____],] [a minimum Heating Seasonal Performance Factor (HSPF) of [____],] [____].]

2.3.2 Air Coils

Extended-surface fin and tube type with seamless copper or aluminum tubes with copper or aluminum fins securely bonded to the tubes. On coils with all-aluminum construction, provide tubes of aluminum alloy provide fins of aluminum alloy and provide tube sheets of aluminum alloy. [Provide a coating on [outdoor air] [and] [indoor air] coils as specified in the
paragraph COATINGS FOR FINNED TUBE COILS. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

2.3.3 Supplemental Electric Heaters

Provide electrical resistance heaters [integral with the unit] [for remote installation in ductwork]. Heaters shall have a total capacity as indicated. Provide internal fusing for heaters.

2.3.4 Compressors

For compressors above 70 kW, compressor speed shall not exceed 3450 rpm. For equipment over 35 kW, provide automatic capacity reduction of at least 50 percent of rated capacity. Capacity reduction may be accomplished by cylinder unloading, use of multiple, but not more than four compressors, or a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have a means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shutdown by safety controls. Provide reciprocating compressors with crankcase heaters, and vibration isolators.

2.3.5 Mounting Provisions

Provide units that permit mounting as indicated. [Provide suitable lifting attachment plates to enable equipment to be lifted to normal position.]

2.3.6 Temperature Controls

Provide controls as specified in JIS B 8615-1 and as modified herein. Provide indoor thermostats of the adjustable type that conform to applicable requirements of JIS C 9730-1 and JIS C 9730-2-9. Provide manual means for temperature set-back. Provide thermostats capable of controlling supplemental heat as specified in JIS B 8615-1.

2.3.7 Accessories

In addition to accessories specified in JIS B 8615-1, provide the following accessories for heat pump units.

a. Protective grille around outside unit coils

b. Start capacitor kit

2.4 AIR CONDITIONERS

2.4.1 Split-System Type

Provide separate assemblies designed to be used together. Base ratings on the use of matched assemblies. Units shall have a minimum [SEER] [EER] of [_____] when tested in accordance with JIS B 8616 or JIS B 8615-1 as applicable. Provide capacity, electrical characteristics and operating conditions as indicated. Condensers shall provide not less than 10 degrees F liquid subcooling at standard ratings.

2.4.2 Single Zone Units

Provide single zone type units arranged to [draw] [or] [blow] through coil
sections. [Air may be blown or drawn through heating section.]

2.4.3 Multizone Units

Provide multizone type units arranged to [blow through the cooling and heating sections] [draw through the cooling and heating sections] [blow through the individual cooling and heating coils of each zone].

2.4.4 Heaters

Provide as [an integral part of the evaporator-blower unit] [a separate unit for installation in the duct work]. Provide [steam coils] [hot water coils] [gas heaters] [oil heaters] [electric open coils] [electric strip tubular heaters] [electric fin tubular heaters].

2.4.5 Compressors

For compressors over 70 kW, compressor speed shall not exceed 3450 rpm. For systems over 35 kW provide automatic capacity reduction of at least 50 percent of rated capacity. Capacity reduction may be accomplished by cylinder unloading, use of multi- or variable speed compressors, use of multiple, but not more than four compressors, or a combination of the two methods. Units with cylinder unloading shall start with capacity reduction devices in the unloaded position. Units with multiple compressors shall have means to sequence starting of compressors. Provide compressors with devices to prevent short cycling when shut down by safety controls. Device shall delay operation of compressor motor for at least 3 minutes but not more than 6 minutes. Provide a pumpdown cycle for units 70 kW and over. Provide reciprocating compressors with crankcase heaters in accordance with the manufacturer's recommendations. If compressors are paralleled, provide not less than two independent circuits.

2.4.6 Coils

On coils with all-aluminum construction, provide tubes of aluminum alloy; provide fins of aluminum alloy and provide tube sheets of aluminum alloy. Provide a separate air cooled condenser circuit for each compressor or parallel compressor installation. [Provide a coating on [condenser] [and] [evaporator] coils and fins as specified in the paragraph COATINGS FOR FINNED TUBE COILS. Coils to be coated shall be part of manufacturer's standard product for capacities and ratings indicated and specified. Provide plate type fins.]

2.4.7 Condenser Controls

Provide start-up and head pressure controls to allow for system operation at ambient temperatures down to [_____] degrees C.

2.4.8 Fans

Provide belt-driven evaporator fans with adjustable pitch pulleys; except for units less than 17 1/2 kW capacity, direct drive with at least two speed taps may be used. Select pulleys at approximately midpoint of the adjustable range.

2.4.9 Filters

Provide filters of the type specified in this section.
2.4.10 Filter Boxes

Provide when filters are not included integral with air conditioning units. Construct of not less than No. 20 US gage steel with track, hinged access doors with latches, and gaskets between frame and filters. Arrange filters to filter outside and return air. Provide removable filter assemblies, replaceable without the use of tools.

2.4.11 Mixing Boxes

Provide of the physical size to match the basic unit and include equal sized flanged openings, sized to individually handle full air flow. Arrange openings as indicated. Provide openings with dampers of parallel or opposed blade type. Provide opposed blade type for modulating dampers and parallel type for two-position dampers. Connect damper shafts together by one continuous linkage bar. Arrange dampers for [automatic] [ or] [ manual] operation so that when one starts to close from its opened position, the other starts to open from its closed position.

2.4.12 Thermostats

Provide adjustable type that conforms to applicable requirements of JIS C 9730-1 and JIS C 9730-2-9. Provide combination heating-cooling type with contacts hermetically sealed against moisture, corrosion, lint, dust, and foreign material. Design to operate on not more than 0.83 degrees C differential and of suitable range calibrated in degrees C. Provide adjustable heat anticipation and fixed cooling anticipation. Provide two independent temperature sensing elements electrically connected to control the compressor and heating equipment, respectively. Accomplish manual switching for system changeover from heating to cooling or cooling to heating and fan operation through the use of a thermostat subbase. Provide system selector switches to provide "COOL" and "OFF" and "HEAT" and fan selector switches to provide "AUTOMATIC" and "ON." Provide relays, contactors, and transformers located in a panel or panels for replacement and service.

2.4.12.1 Cooling

a. When thermostat is in "COOL" position with fan selector switch in "AUTO" position, compressor, evaporator fan, and condenser fan shall cycle together.

b. When thermostat is in "COOL" position with fan selector switch in "ON" position, compressor, and condenser fan shall cycle together and evaporator fan shall run continuously.

2.4.12.2 Heating

a. When thermostat is in "HEAT" position with fan selector switch in "AUTO" position, heater and supply air fan shall cycle together. Provide a separate thermostat to keep the fan running until the heater cools.

b. When thermostat is in "HEAT" position with fan selector switch in "ON" position, heater shall cycle and supply air fan shall run continuously.

2.4.12.3 Supply Air Fan

a. When fan selector switch is in "AUTO" position with thermostat in "OFF"
position, fan shall not run.

b. When fan selector switch is in "ON" position, fan shall run continuously.

2.5 FILTERS

Provide filters to filter outside air and return air and locate [as indicated] [inside air conditioners] [inside filter box] [inside combination air filter mixing box]. Provide [replaceable (throw-away)] [high efficiency] [cleanable (reusable)] type. Filters shall conform to JIS B 9908-1. Polyurethane filters shall not be used on units with multiframe filters.

2.5.1 Replaceable Type Filters

Throw-away frames and media, standard dust holding capacity, 1.79 m/s maximum face velocity, and [25 mm] [50 mm] thick. Filters shall be in accordance with JIS B 9908-1.

2.5.2 High Efficiency Filters

Filters shall have a 99.97% efficiency on 0.30 pm particle when tested in accordance with JIS B 9908-1. Filter assembly shall include; holding frame and fastener assembly, filter cartridge, mounting frame, and retainer assembly. Reinforce filter media with glass fiber mat. Pressure drop across clean filter shall not exceed [_____] Pa gage. Precede high efficiency filters with a replaceable type filter.

2.5.3 Cleanable Type Filters

Provide sufficient oil to coat filters six times based on one pint of oil per each 0.93 square meter of filter area. Provide washing and charging tanks for cleaning and coating filters. Filters shall be in accordance with JIS B 9908-1.

2.5.4 Manometers

Provide inclined-type manometers for filter stations of 944 L/s capacity or larger including filters furnished as integral parts of air-handling units and filters installed separately. Provide sufficient length to read at least 250 Pa with 10 major graduations, and equipped with spirit level. Equip manometers with overpressure safety traps to prevent loss of fluid, and two three-way vent valves for checking zero setting. [Mercury shall not be used as the operating fluid.]

2.6 COATINGS FOR FINNED TUBE COILS

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.6.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by
immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness shall be 0.064 to 0.076 mm.

2.6.2 Chemical Conversion Coating with Polyelastomer Finish Coat

Dip coils in a chemical conversion solution to molecularly deposit a corrosion resistant coating by electrolysis action. Cure conversion coating at a temperature of 43 to 60 degrees C for a minimum of 3 hours. Coat coil surfaces with a complex polymer primer with a dry film thickness of 0.025 mm. Cure primer coat for a minimum of 1 hour. Using dip tank method, provide three coats of a complex polyelastomer finish coat. After each of the first two finish coats, cure the coils for 1 hour. Following the third coat, spray a fog coat of an inert sealer on the coil surfaces. Total dry film thickness shall be 0.064 to 0.076 mm. Cure finish coat for a minimum of 3 hours. Coating materials shall have 300 percent flexibility, operate in temperatures of minus 46 to plus 104 degrees C, and protect against atmospheres of a pH range of 1 to 14.

2.6.3 Vinyl Coating

Apply coating using an airless fog nozzle. For each coat, make at least two passes with the nozzle. Materials to be applied are as follows:

Total dry film thickness, 0.165 mm maximum.

Vinyl Primer, 24 percent solids by volume: One coat 0.051 mm thick

Vinyl Copolymer, 30 percent solids by volume: One coat 0.114 mm thick.

2.7 MOTORS AND STARTERS

JIS C 4212 or JEM 1038, and JEM 1167. Variable speed. Motors less than 3/4 kW shall meet JIS C 4212 requirements. Motors 3/4 kW and larger shall meet JIS C 4212 requirements. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Provide motors to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. [Provide reduced voltage type motor starters.] Provide [general-purpose] [weather-resistant] [watertight] [explosion proof] type starter enclosures.

2.8 REFRIGERANT PIPING AND ACCESSORIES

Provide accessories as specified in [JIS B 8615-1 and] this section. Provide suction line accumulators as recommended by equipment manufacturer's installation instructions. [Provide a filter-drier in the liquid line.]
2.8.1 Factory Charged Tubing

Provide extra soft, deoxidized, bright annealed copper tubing conforming to JIS H 3300, factory dehydrated and furnished with a balanced charge of refrigerant recommended by manufacturer of equipment being connected. Factory insulate suction line tubing with 9.52 mm minimum thickness of closed cell, foamed plastic conforming to manufacturer's standard close cell foamed plastic material with a permeance rating not to exceed 1.0. Provide quick-connectors with caps or plugs to protect couplings. Include couplings for suction and liquid line connections of the indoor and outdoor sections.

2.8.2 Field-Assembled Refrigerant Piping

Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings, and accessories shall conform to in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese product and JIS H 3300 and JIS B 8607, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type K or L, conforming to JIS H 3300, except that tubing with outside diameters of 6.35 mm and 9.52 mm shall have nominal wall thickness of not less than 7.62 mm and 0.81 mm, respectively. Soft annealed copper tubing conforming to JIS H 3300 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.

2.8.3 Fittings

JIS H 3401 for solder-joint fittings. Recommended by manufacturer for flared tube fittings.

2.8.4 Pipe Hangers and Supports

Pipe hangers and supports shall be in accordance with MLIT-M.

2.8.5 Pipe Sleeves

Provide sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 6.35 mm space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and caulk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

2.8.5.1 Sleeves in Masonry and Concrete Walls, Floors, and Roofs

Provide Schedule 40 or Standard Weight zinc-coated steel pipe sleeves. Extend sleeves in floor slabs 80 mm above finished floor.

2.8.5.2 Sleeves in Partitions and Non-Masonry Structures

Provide zinc-coated steel sheet sleeves having a nominal weight of not less than 4.39 kg per square meter, in partitions and other than masonry and concrete walls, floors, and roofs.
2.9 FINISHES

Provide steel surfaces of equipment including packaged terminal units, heat pumps, and air conditioners, that do not have a zinc coating conforming to JIS H 8641, JIS G 3302 or a duplex coating of zinc and paint, with a factory applied coating or paint system. Provide a coating or paint system on actual equipment identical to that on salt-spray test specimens with respect to materials, conditions of application, and dry-film thickness.

2.10 SOURCE QUALITY CONTROL

2.10.1 Salt-Spray Tests

Salt-spray test the factory-applied coating or paint system of equipment including packaged terminal units, heat pumps, and air conditioners in accordance with JIS Z 2371.

2.11 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including cooling towers, cooling tower gear drive assemblies, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life. Plates must be fixed in prominent locations.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinking type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

3.1.1 Packaged Terminal Air Conditioners and Heat Pumps

Wall sleeve installation shall provide a positive weathertight and airtight seal.

3.1.2 Unitary Air Conditioning System

Install as indicated, in accordance with requirements in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese product, and the manufacturer's installation and operational
3.1.3 Room Air Conditioners

Install units in accordance with manufacturer's instructions. Provide structural mountings, closures, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

3.2 Piping

Brazing, bending, forming and assembly of refrigerant piping shall conform to JIS H 3300 and JIS B 8607.

3.2.1 Pipe Hangers and Supports

Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MLIT-M. Installation of hanger types and supports for bare and covered pipes shall conform to MLIT-M. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MLIT-M.

3.2.2 Refrigerant Piping

Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with JIS H 3300 and JIS B 8607.

3.2.3 Returning Oil From Refrigerant System

Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading and corresponding reduction of gas volume. Install a double riser when excess velocity and pressure drop would result from full system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree ells. Arrange small riser with inlet close to bottom of horizontal line, and connect to top of upper horizontal line. Do not install valves in risers.
3.2.4 Refrigerant Driers, Sight Glass Indicators, and Strainers

Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping in accordance with [this section] when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be determined by piping and installation of the unit on location. Install dryers of 820 mL and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed. These devices shall be provided as optional accessories.

3.2.5 Strainer Locations and Installation

Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer's body.

3.2.6 Solenoid Valve Installation

Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans. Trap drain pans from the bottom to ensure complete pan drainage. Provide drain lines full size of drain opening. Traps and piping to drainage disposal points shall conform to Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.4 ACCESS PANELS

Provide access panels for concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

3.5 AIR FILTERS

Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed.

3.6 FLASHING AND PITCH POCKETS

Provide flashing and pitch pockets for equipment supports and roof penetrations and flashing where piping or ductwork passes through exterior walls in accordance with Section 07 60 00 FLASHING AND SHEET METAL.
3.7 IDENTIFICATION TAGS AND PLATES

Provide equipment, gages, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide minimum letter and numeral size of 3.18 mm high.

3.8 FIELD QUALITY CONTROL

3.8.1 Leak Testing

Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in accordance with Japanese Refrigeration Safety Regulations (Nihon-Reitou-Hoan-Kisoku) for Japanese standard. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.

3.8.2 Evacuation, Dehydration, and Charging

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 133 Pa absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions and recharge system.

3.8.3 Start-Up and Initial Operational Tests

Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to ensure proper operation and sequence. Conduct operational tests for not less than 8 hours.

3.8.4 Performance Tests

Upon completion of evacuation, charging, startup, final leak testing, and proper adjustment of controls, test the systems to demonstrate compliance with performance and capacity requirements. Test systems for not less than 8 hours, record readings hourly. At the end of the test period, average the readings, and the average shall be considered to be the system performance. Record the following readings:

[______]
[______]

3.9 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurements commonly agreed on by the manufacturers or other parties. The inch-pound and metric measurements shown are as follows:
<table>
<thead>
<tr>
<th>Products</th>
<th>Inch-Pound</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (____)</td>
<td>(____)</td>
<td>(____)</td>
</tr>
</tbody>
</table>

-- End of Section --
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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135  (2016) BACnet—A Data Communication Protocol for Building Automation and Control Networks

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.1x  (2010) Local and Metropolitan Area Networks - Port Based Network Access Control

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 201-2  (2013) Personal Identity Verification (PIV) of Federal Employees and Contractors

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8551.01  (2014) Ports, Protocols, and Services Management (PPSM)


1.2  SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Wireless Communication Request; G[, [_____]]
Device Account Lock Exception Request; G[, [_____]]
Multiple IP Connection Device Request; G[, [_____]]
Contractor Computer Cybersecurity Compliance Statements; G[, [_____]]
Contractor Temporary Network Cybersecurity Compliance Statements; G[, [_____]]

SD-02 Shop Drawings
User Interface Banner Schedule; G[, [_____]]
Network Communication Report; G[, [_____]]
Cybersecurity Riser Diagram; G[, [_____]]
Control System Inventory Report; G[, [_____]]
Cybersecurity Interconnection Schedule; G[, [_____]]

SD-03 Product Data
Control System Cybersecurity; G[, [_____]]

SD-11 Closeout Submittals
Password Summary Report; G[, [_____]]
Device Audit Record Upload Software; G[, [_____]]

1.3 CYBERSECURITY DOCUMENTATION

[1.3.1 Cybersecurity Interconnection Schedule
Provide a completed Cybersecurity Interconnection Schedule documenting connections between the installed system and other systems. See Attachment 25 05 11-A.
]

[1.3.2 Network Communication Report
Provide a network communication report. See Attachment 25 05 11-B.
]

1.3.3 Control System Inventory Report
Provide a Control System Inventory report. See Attachment 25 05 11-C.

1.3.4 Cybersecurity Riser Diagram
Provide a Cybersecurity Riser Diagram.

1.4 SOFTWARE UPDATE LICENSING
In addition to all other licensing requirements, all software licensing must include licensing of the following software updates for a period [of no less than 5 years][___]:

SECTION 25 05 11  Page 5
a. Security and bug-fix patches issued by the software manufacturer.

b. Security patches to address any vulnerability identified in the National Vulnerability Database at http://nvd.nist.gov with a Common Vulnerability Scoring System (CVSS) severity rating of MEDIUM or higher.

1.5 CYBERSECURITY DURING CONSTRUCTION

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.5.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, contractor computers must meet the following requirements:

1.5.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.5.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

1.5.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.5.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers that will be connected to network controllers during construction. See Attachment 25 05 11-D.

1.5.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks must meet the following requirements:

1.5.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.
1.5.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.5.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

1.5.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.5.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. If no temporary IP networks will be used, provide a single copy of the Statement indicating this. See Attachment 25 05 11-E.

1.6 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

3.1 ACCESS CONTROL REQUIREMENTS

3.1.1 User Accounts

[3.1.1.1 [_____] Control System Devices

[_____]

]3.1.1.2 Default Requirements for Control System Devices

For control system devices where User Account requirements are not otherwise indicated in this Section:

a. Devices with web interfaces must support user accounts (such as "admin", "user 1", "user 2") or have their web interface disabled.

3.1.2 Unsuccessful Logon Attempts

Except for high availability user interfaces indicated as exempt, devices
must meet the indicated requirements for handling unsuccessful logon attempts.

3.1.2.1 Devices Supporting Accounts

Devices which MINIMALLY support accounts [are not required to lock based on unsuccessful logon attempts][must lock the user input when [_____] and must support unlocking of the user input when [_____]].

3.1.2.2 Devices

Devices which FULLY support accounts must meet the following requirements. If a device cannot meet these requirements, document device capabilities to protect from subsequent unsuccessful logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures without explicit permission from the Government.

a. It must lock the user account when [three][_____] unsuccessful logon attempts occur within a [15 minute][_____] interval.

b. Once an account is locked, the account must stay locked until unlocked by an administrator.

c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.1.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

[There are no high availability interfaces which are exempt from unsuccessful logon attempts requirements.][The following high availability interfaces are exempt from unsuccessful logon attempts requirements:

| High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements |
|---------------------------------|---------------------------------|---------------------------------|
| User Interface | Location | Action to take in lieu of locking screen |
| [_____] | [_____] | [_____] |
| [_____] | [_____] | [_____] |
| [_____] | [_____] | [_____] |

3.1.3 System Use Notification

Web interfaces must display a warning banner meeting the requirements of DTM 08-060.

Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060. Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.
3.1.3.1 User Interface Banner Schedule

Provide a User Interface Schedule using the format indicated showing each user interface provided and how the information banner requirement has been implemented for each user interface.

<table>
<thead>
<tr>
<th>User Interface Schedule Format</th>
<th>User Interface Description</th>
<th>User Interface Location</th>
<th>Type of User Interface</th>
<th>Banner Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample 1</td>
<td>Room 1</td>
<td>Remote</td>
<td>DTM 08-060 Banner &quot;A&quot; Displayed at Logon</td>
</tr>
<tr>
<td></td>
<td>Sample 2</td>
<td>Room 2</td>
<td>Limited Local</td>
<td>DTM 08-060 Banner &quot;B&quot; on Affixed Label</td>
</tr>
<tr>
<td></td>
<td>Sample 3</td>
<td>Room 3</td>
<td>Full Local</td>
<td>DTM 08-060 Banner &quot;B&quot; Displayed on Screen</td>
</tr>
</tbody>
</table>

3.1.4 Permitted Actions Without Identification or Authentication

The control system must require identification and authentication before allowing any actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.1.5 Wireless Access

Unless explicitly authorized by the Government, do not use any wireless communication. Any device with wireless communication capability is considered to be using wireless communication, regardless of whether or not the device is actively communicating wirelessly, except when wireless communication has been physically permanently disabled (such as through the removal of the wireless transceiver).

3.1.5.1 Wireless IP Communications

[Unless specifically approved and installed in accordance with the project site requirements, do not install wireless IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.]

When explicitly authorized by the Government, wireless IP communication may be used to communicate with an existing wireless network.

3.1.5.2 Non-IP Wireless Communication

When non-IP wireless communication is explicitly authorized by the Government, use the maximum level of encryption supported by the specific protocol employed and select signal strength and radiated power to the minimum necessary for reliable communication.
3.1.5.3 Wireless Communication Request

Provide a report documenting the proposed use of wireless communication prior to beginning construction using the Wireless Communication Request Schedule. See Attachment 25 05 11-F.

3.2 CYBERSECURITY AUDITING

3.2.1 Audit Events, Content of Audit Records, and Audit Generation

For devices that have STIG/SRGs related to audit events, content of audit records or audit generation, comply with the requirements of those STIG/SRGs.

3.2.1.1 Computers

For each computer, provide the capability to select audited events and the content of audit logs. Configure computers to audit the indicated events, and to record the indicated information for each auditable event.

3.2.1.1.1 Audited Events

Configure each computer to audit the following events:

a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)

b. Successful and unsuccessful logon attempts

c. Privileged activities or other system level access

d. Starting and ending time for user access to the system

e. Concurrent logons from different workstations

f. All program initiations

g. All direct access to the information system

h. All account creations, modifications, disabling, and terminations

i. All kernel module load, unload, and restart

3.2.1.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

a. What type of event occurred

b. When the event occurred

c. Where the event occurred

d. The source of the event
e. The outcome of the event
f. The identity of any individuals or subjects associated with the event

3.2.1.2 For HVAC Control System Devices

3.2.1.2.1 HVAC Control System Devices FULLY Supporting User Accounts

For devices FULLY supporting accounts, provide the capability to select audited events, and the contents of audit logs. Configure devices to audit the following events:

a. Successful and unsuccessful logon attempts to the device
b. Starting and ending time for user access to the device
c. All account creations, modifications, disabling, and terminations
d. All device shutdown and startup

Configure the device to record for each event the following information (as applicable): the type of event, when the event occurred and the identity of any individuals or subjects associated with the event

3.2.1.2.2 Other HVAC Control System Devices

There are no requirements to perform auditing at HVAC field devices that do not FULLY support accounts.

[3.2.1.3 ______] Control System Devices

[____]

3.2.1.4 Default Requirements for Control System Devices

For control system devices where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.2.1.4.1 Devices Which FULLY Support Accounts

For each device which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure devices to audit the indicated events, and to record the indicated information for each auditable event

3.2.1.4.1.1 Audited Events

Configure each device to audit the following events:

a. Successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels)

a. Successful and unsuccessful logon attempts
b. Privileged activities or other system level access
c. Starting and ending time for user access to the system
d. Concurrent logons from different workstations

  e. All account creations, modifications, disabling, and terminations

  f. All kernel module load, unload, and restart

3.2.1.4.1.2 Audit Event Information To Record

Configure each computer to record, for each auditable event, the following information (where applicable to the event):

  a. what type of event occurred

  b. when the event occurred

  c. where the event occurred

  d. the source of the event

  e. the outcome of the event

  f. the identity of any individuals or subjects associated with the event

3.2.1.4.2 Devices Which Do Not FULLY Support Accounts

For each Device which does not FULLY support accounts configure the device to audit all device shutdown and startup events and to record for each event the type of event and when the event occurred.

3.2.2 Audit Storage Capacity and Audit Upload

{For Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

  a. For devices that have STIG/SRGs related to audit storage capacity (CCI-001848 or CCI-001849) comply with the requirements of those STIG/SRGs.

  b. For non-computer control system devices capable of generating audit records, provide [60][_____] days worth of secure local storage, assuming [10][_____] auditable events per day.

  c. For computers, provide storage for at least [_____] audit records.

3.2.2.1 Device Audit Record Upload Software

For each non-computer device required to audit events, provide, and license to the Government, software implementing a secure mechanism of uploading audit records from the device to a computer and of exporting the uploaded audit records as a [Microsoft Excel file][comma separated value text file][Microsoft Excel file or comma separated value text file][______]. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

[Install device audit record upload software on the furnished front end computer in [_____]]. [Install device audit record upload software on [_____]]. Submit copies of device audit record upload software. If there are no non-computer devices requiring auditing, provide a document stating
this in lieu of this submittal.

3.2.3 Response to Audit Processing Failures

{For Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490}.

Front end computers associated with auditing must, in the case of a failure in the auditing system, notify [_____] via [e-mail][______]. In case of an audit failure, if possible, continue to collect audit records by [overwriting existing audit records][______].

3.2.4 Time Stamps

3.2.4.1 Computers

Computers generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks must not drift more than 10 seconds per day.

Configure the system so that each computer generating audit records maintains accurate time to within 1 second.

3.2.4.2 For HVAC Control System Devices

[Time stamp requirements for HVAC Control Systems are as indicated in the HVAC Control System specifications.] [Devices generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks cannot drift more than 10 seconds per day. Configure the system so that each device generating audit records maintains accurate time to within 1 second.]

3.2.4.3 [_____] Control System Devices

[_____] [Time stamp requirements for [_____] Control Systems are as indicated in the Control System specifications.] [Devices generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks cannot drift more than 10 seconds per day. Configure the system so that each device generating audit records maintains accurate time to within 1 second.]

3.2.4.4 Default Requirements for Control System Devices

For control system devices where Time Stamps requirements are not otherwise indicated in this Section: Devices generating audit records must have internal clocks capable of providing time with a resolution of 1 second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device generating audit records maintains accurate time to within 1 second.

3.3 REQUIREMENTS FOR LEAST FUNCTIONALITY

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

For HVAC Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a
non-networked sensor or actuator would suffice.

For Other Control Systems: [Do not provide devices with user interfaces where one was not required.] [Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.]

3.3.1 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol, or use any protocol on ports other than those specified.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.3.2 IP Control Networks

Do not use nonsecure functions, ports, protocols and services as defined in DODI 8551.01 unless those ports, protocols and services are specifically required by the control system specifications or otherwise specifically authorized by the Government. Do not use ports, protocols and services that are not specified in the control system specifications or required for operation of the control system.

3.4 SAFE MODE AND FAIL SAFE OPERATION

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.5 IDENTIFICATION AND AUTHENTICATION

3.5.1 User Identification and Authentication

{For Reference Only: This subpart (and its subparts) relates to IA-2,(1),(12); CCI-000764, CCI-000765, CCI-001953, CCI-001954}

a. Devices that FULLY support accounts must uniquely identify and authenticate organizational users.

b. Devices which allow network access to privileged accounts must implement multifactor authentication for network access to privileged accounts.

3.5.1.1 HVAC Control Systems Devices

Identification and Authentication for network access to privileged accounts must be implemented by either accepting and electronically verify Personal Identity Verification (PIV) credentials or inheriting identification and authentication from the operating system.

3.5.1.2 Electronic Security System Devices

Identification and Authentication for network access to privileged accounts must be implemented by [accepting and electronically verifying Personal Identity Verification (PIV) credentials][or][inheriting identification and authentication from the operating system][or][______].
3.5.1.3  [___] Control System Devices

[___]

3.5.1.4  Default Requirements for Control System Devices

For control system devices where User Identification and Authentication requirements are not otherwise indicated in this Section, User Identification and Authentication for network access to privileged accounts must be implemented by [accepting and electronically verify Personal Identity Verification (PIV) credentials][or][inheriting identification and authentication from the operating system][or][___].

3.5.2  Authenticator Management

3.5.2.1  Authentication Type

3.5.2.1.1  For HVAC Control System Devices

Unless otherwise indicated:

a. Software which FULLY supports accounts and which runs on a computer must use [password-based authentication or hardware token-based authentication][password-based authentication][hardware token-based authentication].

b. Other devices which FULLY support accounts must use password-based authentication.

c. Devices MINIMALLY supporting accounts must use password-based authentication.

3.5.2.1.2  [___] Control System Devices

[___]

3.5.2.1.3  Default Requirements for Control System Devices

For control system devices where Authentication Type requirements are not otherwise indicated in this Section:

a. Software which FULLY supports accounts and which runs on a computer must use [password-based authentication or hardware token-based authentication][password-based authentication][hardware token-based authentication].

b. Other devices which FULLY support accounts must use [either password-based authentication or hardware token-based authentication][password-based authentication][hardware token-based authentication].

c. Devices MINIMALLY supporting accounts must use [either password-based authentication or hardware token-based authentication][password-based authentication][hardware token-based authentication].

3.5.2.2  Password-Based Authentication Requirements

3.5.2.2.1  Passwords for Computers

All computers supporting password-based authentication must enforce the
following requirements:

a. Minimum password length of 12 characters
b. Password must contain at least one uppercase character.
c. Password must contain at least one lowercase character.
d. Password must contain at least one numeric character.
e. Password must contain at least one special character.
f. Password must have a minimum lifetime of 24 hours.
g. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
h. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.
i. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.2 Passwords for Non-Computer Devices FULLY Supporting Accounts

All non-computer devices FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

a. Minimum password length of twelve (12) characters
b. Password must contain at least one uppercase character.
c. Password must contain at least one lowercase character.
d. Password must contain at least one numeric character.
e. Password must contain at least one special character.
f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.
g. Password must differ from previous five (5) passwords, where differ is defined as changing at least fifty percent of the characters.
h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.3 Passwords for Web Interfaces

Passwords for connecting to a web interface supporting password-based authentication must enforce the following requirements:

a. Minimum password length of 12 characters
b. Password must contain at least one uppercase character.
c. Password must contain at least one lowercase character.
d. Password must contain at least one numeric character.

e. Password must contain at least one special character.

f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.

g. Password must differ from previous five passwords, where differ is defined as changing at least 50 percent of the characters.

h. Passwords must be cryptographically protected during storage and transmission.

3.5.2.2.4 Passwords for Devices Minimally Supporting Accounts

Devices minimally supporting accounts must support passwords with a minimum length of [four] characters.

3.5.2.2.5 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Coordinate selection of passwords with [_____]. Do not use the same password for more than one device unless specifically instructed to do so. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Password Summary Report in electronic format. Provide [two] hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.5.2.3 Hardware Token-Based Authentication Requirements

Devices supporting hardware token-based authentication must use Personal Identity Verification (PIV) credentials for the hardware token.

3.5.3 Authenticator Feedback

{For Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGS/SRGs.

3.5.4 Device Identification and Authentication

All computers must use IEEE 802.1x for authentication to the network. All web servers running on computers must use HTTPS[ and must implement HTTPS using web server certificates obtained from [_____]]. [When wireless IP devices are permitted, they must use [_____] for authentication.]

3.5.4.1 For HVAC Control System Devices

Devices using Fox Protocol must use HTTPS[ using a web server certificate obtained from [_____]]. [Devices using Fox Protocol must support IEEE 802.1x. ][Devices using Ethernet must support IEEE 802.1x. ][Devices using BACnet must support Network Security as specified in Clause 24 of]
3.5.4.2  [_____] Control System Devices

[_____]

3.5.4.3  Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: [Devices using Ethernet must support IEEE 802.1x. ] Devices using HTTP as a control protocol must use HTTPS[ using a web server certificate obtained from [_____]] instead.

3.5.5  Cryptographic Module Authentication

{For Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.6  EMERGENCY POWER

[Emergency power is specified in the control system and equipment specifications.][_____]

3.7  DURABILITY TO VULNERABILITY SCANNING

All IP devices must be scannable, such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application, or functionality.

[Computers must respond to scans from [_____] by responding with a [_____]. ] For control system devices other than computers:

3.7.1  HVAC Control System Devices Other Than Computers

HVAC control system devices other than computers are not required to respond to scans.

3.7.2  [_____] Control System Devices Other Than Computers

[_____] control system devices other than computers [must respond to scans from [_____] by responding with a [_____]][are not required to respond to scans].

3.7.3  Default Requirements for Control System Devices

Non-computer control system devices where Durability to Vulnerability Scanning requirements are not otherwise indicated in this Section [must respond to scans from [_____] by responding with a [_____]][are not required to respond to scans].

3.8  FIPS 201-2 REQUIREMENT

{For Reference Only: This subpart (and its subparts) relates to SA-4 (10); CCI-003116}
Devices in the following systems which implement PIV must be on the
NIST FIPS 201-2 approved product list: [NONE][electronic security
systems(ESS)][______].

3.9 DEVICES WITH CONNECTION TO MULTIPLE IP NETWORKS

Except for Ethernet switches, do not use more than one physical connection
to IP networks on the same device unless doing so is both required by the
project specifications and the specific application is approved. If a
device with multiple IP connections is required, provide a Multiple IP
Connection Device Request using the Multiple IP Connection Device Request
Schedule to request approval for each device.

3.10 SYSTEM AND COMMUNICATION PROTECTION

3.10.1 Denial of Service Protection, Process Isolation and Boundary
Protection

To the greatest extent practical, implement control logic in non-computer
hardware and without reliance on the network.

3.10.2 Cryptographic Protection

For devices that have STIG/SRGs related to cryptographic protection
(CCI-002450), comply with the requirements of those STIG/SRGs. Ensure that
[all][IP][_____] network traffic is encrypted using NSA-approved
cryptography; provision of digital signatures and hashing, and
FIPS-validated cryptography.

3.11 SYSTEM AND INTEGRATION INTEGRITY

3.11.1 Malicious Code Protection

For all computers installed under this project, install and configure
malware protection software in accordance with the relevant STIGs.

3.11.2 Information System Monitoring

[______]

3.12 FIELD QUALITY CONTROL

3.12.1 Tests

In addition to testing and testing support required by other Sections,
provide a minimum of [______] hours of technical support for cybersecurity
testing of control systems.

-- End of Section --
This page was intentionally left blank for duplex printing.
<table>
<thead>
<tr>
<th>Device ID</th>
<th>Device Description</th>
<th>Foreign Destination</th>
<th>Point of Contact for Destination</th>
<th>Transport layer Protocol</th>
<th>Network Address</th>
<th>Port (if applicable)</th>
<th>MAC (Layer 2) address (if applicable)</th>
<th>Media</th>
<th>Application Protocol</th>
<th>Service (if applicable)</th>
<th>Descriptive Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMCS M&amp;C Server</td>
<td>UMCS M&amp;C Server</td>
<td>Exchange Server</td>
<td>IT email POC</td>
<td>TCP/25</td>
<td>10.0.5.23</td>
<td>25</td>
<td>SMTP</td>
<td>IM</td>
<td>email to email or SMS service for alarm messaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCC-5</td>
<td>AHU-5 Controller</td>
<td>UMCS Front End</td>
<td>&lt;Energy Manager&gt;</td>
<td>P</td>
<td>10.250.45.103</td>
<td>53</td>
<td>BACnet</td>
<td>IM</td>
<td>Trend upload, interactive data sharing with M&amp;C server, alarms</td>
<td></td>
<td></td>
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<tr>
<td>DCC-8</td>
<td>Chiller Controller</td>
<td>UMCS Front End</td>
<td>&lt;Energy Manager&gt;</td>
<td>P</td>
<td>10.250.45.78</td>
<td>53</td>
<td>BACnet</td>
<td>IM</td>
<td>Trend upload, interactive data sharing with M&amp;C server, alarms</td>
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<tr>
<td>DCC-3</td>
<td>Supervisory Controller</td>
<td>UMCS Front End</td>
<td>&lt;Energy Manager&gt;</td>
<td>P</td>
<td>10.250.45.34</td>
<td>53</td>
<td>BACnet</td>
<td>IM</td>
<td>Read Property, Write Property Used by front end for demand limiting in building</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCC-6</td>
<td>Lighting Gateway</td>
<td>Lutron Lighting Gateway</td>
<td>Lighting system owner</td>
<td>TCP/FT-10</td>
<td>313.24.12 (Domain, Subnet, Node)</td>
<td>NA</td>
<td>Lon</td>
<td>IM</td>
<td>Communicate occupancy status with lighting system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is a sample entry for a UMCS front end and M&C server.

These are sample entries for a HVAC building control system for a separate front end.
<table>
<thead>
<tr>
<th>Device ID</th>
<th>Device Description</th>
<th>Transport layer Protocol</th>
<th>Network Address</th>
<th>Port (if applicable)</th>
<th>MAC (Layer 2) address (if applicable)</th>
<th>Media</th>
<th>Application Protocol</th>
<th>Service (if applicable)</th>
<th>Descriptive Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC-M</td>
<td>Lighting Controller (main panel)</td>
<td>IP</td>
<td>0.0.5.23</td>
<td>80</td>
<td>00:24:B9:B5:A5:34</td>
<td>Fiber</td>
<td>SMTP</td>
<td>Commands between base-wide lighting controller and building controller</td>
<td>Lighting Controller for remote video teleconferencing</td>
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<table>
<thead>
<tr>
<th>Identifier</th>
<th>Installation</th>
<th>Special Area</th>
<th>Facility Number or Identifier</th>
<th>Facility Name or Description</th>
<th>Floor</th>
<th>Room</th>
<th>Location In Room</th>
<th>Enclosure or Mount Type</th>
<th>UPS Power</th>
<th>Architecture Level</th>
<th>Control System Type</th>
<th>Part of which UMCS</th>
<th>Electrical/Mechanical System or Equipment Controlled</th>
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</tbody>
</table>

**HARDWARE DETAILS**

<table>
<thead>
<tr>
<th>Device Location</th>
<th>Control System Info</th>
<th>OPERATING SYSTEM &amp; PLATFORM</th>
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</thead>
<tbody>
<tr>
<td>Device Type</td>
<td>Device Sub-Type</td>
<td>Device Function</td>
</tr>
<tr>
<td>Device Manufacturer</td>
<td>Product Line</td>
<td>Model #</td>
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<tr>
<td>Platform Vendor</td>
<td>Platform Product Line</td>
<td>Platform Version</td>
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</table>

25 05 11-C
Contractor Computer Cybersecurity Compliance Statement

Number of contractor-owned computers used during construction: _____

For each contractor-owned computer, list the make and model of the device, the device serial number, the operating system version, and the anti-malware software version. Attach additional sheets if required to document all computers.

Number of additional sheets attached: ______

<table>
<thead>
<tr>
<th>Make/Model</th>
<th>Serial Number(s)</th>
<th>Operating System Type and Version</th>
<th>Anti-Malware Software Type and Version</th>
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</thead>
<tbody>
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</table>

I hereby certify that:

- The information provided above is accurate as of the date this document is signed
- All computers listed will be provided any and all patches and updates released during the period of construction
- The computers listed above will be scanned by Anti-Malware software at least once per day during the period of construction.
- Passwords for computers have been changed from defaults

Signature: _______________________________ Date: _______________

Completed By:

Name: _______________________________

Position Title: _______________________

Company: ____________________________
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Contractor Temporary Network Cybersecurity Compliance Statement

Check ONE: Temporary IP networks (__) WILL or (__) WILL NOT be used

Check ONE: Temporary Wireless IP networks (__) WILL or (__) WILL NOT be used

I hereby certify that:
- Temporary IP networks will not connect to any other IP network.
- Temporary IP networks will not extend outside the project site.
- Temporary Wireless IP networks will use WPA2 encryption.
- There will be NO off-site access of any kind to temporary networks.
- Passwords for network hardware and network access have been changed from defaults.

Signature: ___________________________           Date: ______________

Completed By:

Name: ______________________________

Position Title: ______________________

Company: __________________________
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<th>Device Description</th>
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<th>RF Frequency</th>
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<th>Free-space range</th>
<th>As-installed range</th>
<th>Approved (Y/N)</th>
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Network connectivity at required points (Y/N): [ ]

Wireless Network Request form (during construction)
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THREE-PHASE, CUBICLE-TYPE PAD-MOUNTED TRANSFORMER

08/19

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PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS B 1178 (2015) Foundation Bolts (Amendment 1)


JIS C 1102-1 (2007) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 1: Definitions And General Requirements Common To All Parts

JIS C 1102-2 (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 2: Special Requirements For Ammeters And Voltmeters

JIS C 1102-3 (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 3: Special Requirements For Wattmeters And Varmeters

JIS C 1102-4 (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 4: Special Requirements For Frequency Meters

JIS C 1102-5 (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 5: Special Requirements For Phase Meters, Power Factor Meters And Synchroscopes

JIS C 1102-6 (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 6: Special Requirements For Ohmeters (Impedance Meters) And Conductance Meters

JIS C 1102-7 (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 7: Special Requirements For Multi-Function Instruments
JIS C 1102-8  (1997) Direct Acting Indicating Analogue Electrical Measuring Instruments And Their Accessories Part 8: Special Requirements For Accessories


JIS C 1281  (1979) Weather-Proof Performance Of Electricity Meters


JIS C 3611  (1991) Insulated Wires for Cubicle Type Unit Substation for 6.6 KV Receiving

JIS C 3814  (1999) Indoor Post Insulators

JIS C 3851  (2012) Indoor Post Insulator Of Organic Material

JIS C 4304  (2013) 6 KV Oil-Immersed Distribution Transformers

JIS C 4306  (2013) 6 kV mold transformer for distribution

JIS C 4603  (1990) Ac Circuit Breakers For 3.3 kV or 6.6 kV

JIS C 4604  (2017) High Voltage Current-Limiting Fuses

JIS C 4605  (1998) AC Load Break Switches for 3.3 kV or 6.6 kV

JIS C 4606  (R2011) Indoor Use Disconnectors for 3.3 kV or 6.6 kV
JIS C 4607  (1999) Ac Load Break Switches With Tripping Device for 3.3 kV or 6.6 kV

JIS C 4608  (2015) Surge arresters for 6.6 kV Cubicle Type Unit Substation

JIS C 4611  (1999) High-voltage alternating current switch-fuse combinations

JIS C 4620  (2018) Cubicle Type High Voltage Power Receiving Units


JIS C 8106  (2015) Luminaires With Led Light Source Fluorescent Lamp For Commercial, Industrial And Public Lighting


JIS C 8201-7-1  (2016) Low-Voltage Switchgear And Control Gear -- Part 7-1: Ancillary Equipment -- Terminal Blocks For Copper Conductors

JIS C 8303  (2007) Plugs And Receptacles For Domestic And Similar General Use

JIS C 8364  (2008) Busways

JIS C 8480  (R2016) Box-Type Switchgear Assemblies for Low-Voltage Distribution Purpose

JIS G 3553  (2011) Crimped Wire Cloth (Amendment 1)


JIS G 3555 PW-S  (2015) The most basic way of weaving, where vertical and horizontal lines are kept at regular intervals and intersect each other one by one. (Translated Japanese)

JIS H 3140  (2018) Copper Bus Bars

JIS H 8641  (2007) Hot Dip Galvanized Coatings

1.2 RELATED EQUIPMENT

Section 26 00 00.00 20, BASIC ELECTRICAL MATERIAL AND METHOD, applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
  Cubicle Type Unit Substation Including Concrete Foundation
  Distribution panel
  Cubicle type unit switching station including concrete foundation
Switchgear including concrete foundation

SD-03 Product Data (Catalog Data)

Transformers; G[ , [ ]]
Primary Cutout (PC)G[, [ ]]
Disconnecting Switches (DS); G[, [ ]]
Load Disconnecting Switches (LDS); G[, [ ]]
Vacuum Circuit Breaker (VCB); G, [ ]
Load Break Switches (LBS); G[, [ ]]
Load Break Switches (LBS) with tripping device; G[, [ ]]
Load Break Switches (LBS) with fuse; G[, [ ]]
Circuit breaker; G[, [ ]]
Circuit Breaker with GFCI; G[, [ ]]
Automatic Transfer Switch (ATS); G[, [ ]]
Power Fuses (PF); G FIO [, [ ]]
Instruments; G[, [ ]]
Instrument Control Switches; G[, [ ]]
Buzzer
Test Terminal
Lightning Arrester; G[, [ ]]

SD-06 Test Reports
Acceptance Checks and Tests
SD-10 Operation and Maintenance

Data Transformer(s), Data Package 5; G[, [ ]]

1.4 QUALITY ASSURANCE

1.4.1 PCB Free Certificate

Submit results of PCB analysis in transformer oil to certify that the transformers installed under this contract are PCB free transformer as specified in Paragraph Also, analysis results shall be required maker name, serial number and other identification data of the transformers which are taken and analyzed oil samples. Analysis results appearing PCB rate shall be submitted to and approved by the Contracting Officer prior to install the transformers. The certificate shall include "PCB analysis report" prepared by the Contractor and "PCB-free certificate" prepared by the transformer manufacturer.
1.4.2   Lead-Containing Paint Material

Use of lead-containing paint shall not be permitted. Submit the Certification of Lead Free for each enclosure, and field-applied paint in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

1.4.3   Cubicle Type Transformer Drawings

Include the following as a minimum:

a. An outline drawing, including front, top, and side views.

b. Nameplate data.

c. Elementary diagrams and wiring diagrams [with terminals identified of watthour meter and current transformers].

d. One-line diagram, including switch(es) [, current transformers, meters, and fuses].

1.4.4   Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, except when more stringent requirements are specified or indicated, as though the word "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with applicable codes and standards unless more stringent requirements are specified or indicated.

1.4.5   Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.6   Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.
1.5 MAINTENANCE

1.5.1 Additions to Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted
b. An outline drawing, front, top, and side views
c. Prices for spare parts and supply list
d. Routine and field acceptance test reports
e. Fuse curves for primary fuses

[f. Information on watthour demand meter, CT's, and fuse block]

g. Actual nameplate diagram

h. Date of purchase

PART 2 PRODUCTS

2.1 GENERAL

MLIT ESS. Substation shall be open-type switchgear for secondary distribution with transformation. The substation assembly shall consist of [one] incoming section, [one] transformer section and [one] distribution section. Dimension and feature of the substation shall be as indicated.

2.2 MATERIALS AND EQUIPMENT

All materials, equipment, and devices shall, as a minimum, meet the requirements of JIS where JIS Standards are established for those items, and the requirements of MLIT ESS. All items shall be new unless specified or indicated otherwise.

2.3 MODIFICATION OF CUBICLE TYPE UNIT SUBSTATION

JIS C 4620 and MLIT ESS. [ Substation shall be metal enclosed station type cubicle switchgear for secondary distribution with transformation. The substation assembly shall consist of [one] incoming section, [one] transformer section and [one] distribution section. External doors shall be suitable for handle key. Enclosure of the substation, inside enclosure and oil transformers shall be coated by salt-air proofing paint, heavy-duty type. Dimension and feature of the substation shall be as indicated.]

2.4 TRANSFORMERS SECTION

2.4.1 Unit Frame

Unit frame shall conform to JEM 1459.
2.4.2 Transformer

Oil immersed transformer shall conform to JIS C 4304. Transformer shall be high-efficiency type.

[Molded transformer shall conform to JIS C 4306. Transformer shall be high-efficiency type.]

[Extra-high voltage type transformer shall conform to JEC 2200.]

Voltage tap shall be changed by outside setting.

2.4.2.1 Transformer (Insulation) Oil

The use of PCB containing oil shall not be permitted. Before installation of transformer, the new transformer oil shall be tested in accordance with the method described in the latest Law of the Japanese Government, and submit PCB free certificate with its testing method to the Contracting Officer. Materials containing PCBs (0.5 ppm and above) shall not be permitted to use.

2.5 [MODIFICATION OF ]CUBICLE TYPE UNIT SWITCHING STATION

JIS C 4620 and MLIT ESS. [Switching station shall be metal enclosed station-type cubicle switchgear for feeder distribution. The switching station assembly shall consist of [one][ ] incoming section, and [one][ ] distribution section. External doors shall be suitable for handle key. Enclosure of the switching station and inside enclosure shall be coated by salt-air proofing paint, heavy-duty type. Dimension and feature of the switching station shall be as indicated.]

2.6 [MODIFICATION OF ]SWITCHGEAR

[JIS C 4620] [JEM 1425] and MLIT ESS. [Switchgear shall be metal enclosed [metal-clad] [cubicle] type switchgear for feeder distribution.] The switchgear assembly shall consist of [one] [_____] incoming section, and [one] [_____] distribution section. External doors shall be suitable for handle key. Enclosure of the switchgear and inside enclosure shall be coated by salt-air proofing paint, heavy-duty type. Dimension and feature of the switchgear shall be as indicated.

2.6.1 Interrupter Switch for Extra-High-voltage

2.6.1.1 Primary Cutout (PC)

As recommended by the primary cutout manufacturer.

2.6.1.2 Disconnecting Switches (DS)

Shall conform to JEC 2310.

2.6.1.3 Vacuum Circuit Breaker (VCB)

Shall conform to JEC 2300.
2.6.2 Interrupter Switch for High-Voltage

2.6.2.1 Primary Cutout (PC)

Shall conform to JIS C 4620, Appendix C.

2.6.2.2 Load Disconnecting Switches (LDS)

Shall conform to JIS C 4606.

2.6.2.3 Load Break Switches (Lbs)

Shall conform to JIS C 4605.

LDS means fuse less type of Load Break Switches (LBS).

2.6.2.4 Load Break Switches (LBS) With Tripping Device

Shall conform to JIS C 4607.

2.6.2.5 Load Break Switches (LBS) With Fuse

Shall conform to JIS C 4611. Power fuses (PF) shall conform to JIS C 4604.

2.6.2.6 Vacuum Circuit Breaker (VCB)

Shall conform to JIS C 4603.

2.7 DISTRIBUTION SECTION

Distribution switchboard shall be circuit breaker-equipped unless indicated otherwise. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by JEM. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Directories shall be typed to indicate load served by each circuit and mounted in holder behind transparent protective covering.

2.7.1 Unit Frame

Unit frame shall conform to JEM 1459.

2.7.2 Cubicle Type Cabinet

Cabinet shall conform to cubicle-type [JIS C 4620][JEM 1425]. Additional requirements shall be attached at the end of this section as a reference.

2.7.3 Panelboard Type Cabinet

Cabinet shall conform to JIS C 8480 shall have a mounting plate, and shall be provided with wiring gutters of adequate size at top, bottom and sides.

2.7.3.1 Steel Type

Thickness of steel sheet shall be not less than 2.3 mm.

Thickness of sheet steel for the cabinet shall be not less than 2.3 mm for outdoor installation and for indoor installation.
Cabinet located outside the building shall be of hot dip galvanized steel sheet material.

Cabinets shall be painted in accordance with paragraph FACTORY APPLIED FINISH.

2.7.3.2 Stainless Steel Type

Cabinet shall be of Stainless Steel.

2.7.3.3 Weather Proof Type

Cabinet located outside of building and exposure to weather, shall be weather-proofed box.

Weather-proof cabinet shall conform to JIS C 0920 [(IP44)] [(IP54)] [(IPXX and more)] [as indicated] and exposed screws to weather shall be non-corrosive material.

2.7.4 Interrupter Switch for Low-voltage

2.7.4.1 Circuit Breaker

JIS C 8201-2-1, thermal-magnetic, magnetic or solid-state (electronic) type with interrupting capacity as indicated. Plug-in circuit breakers unacceptable.

Interrupting rating of circuit breakers shall be as indicated. If not shown, do not select circuit breakers less than 10,000A asymmetrical interrupting rating for voltages 240V and under, and 14,000A asymmetrical interrupting rating for 480V and under.

2.7.4.2 Circuit Breaker with GFCI

JIS C 8201-2-2, Plug-in circuit breakers unacceptable. Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of [15] [30] milliamperes or greater per requirements or as indicated on drawings.

2.7.5 Automatic Transfer Switch (ATS)

As recommended by the auto transfer switch manufacturer.

2.7.6 Power Factor Improvement Equipments

[Provide as indicated on drawings.][_____

2.7.7 Protective Relays, Metering, and Control Devices

Provide protective relays as indicated [on drawings.] [per manufacturer's recommendations.] [_____]

2.7.7.1 Instruments

General of instruments shall conform to JIS C 1102-1, JIS C 1102-8 and JIS C 1103.

Ammeter (wide-range type), voltmeter (wide-range type) shall conform to
JIS C 1102-2 respectively.
Wattmeters and varmeters shall conform to JIS C 1102-3.
Frequency meters shall conform to JIS C 1102-4.
Phase meters, power factor meters and synchroscopes shall conform to JIS C 1102-5.
Ohmmeters (impedance meters) and conductance meters conform to JIS C 1102-6.
Multi-function instruments shall conform to JIS C 1102-7.
Watt-hour meter with pulse generator shall conform to JIS C 1211-1, JIS C 1211-2, JIS C 1216, JIS C 1281 and JIS C 1283.
Var-hour meter shall conform to JIS C 1263-1.

[Metering shall be compliant with the current Advanced Meter Reading System (AMRS) Electric Meter Specifications.]

2.7.7.2 Instrument Control Switches
Provide rotary cam-operated type with positive means of indicating contact positions.

2.7.7.3 Buzzer
Shall have a sound output rating of at least 90 decibels at 1 m.

2.7.7.4 Test Terminal
Provide current test terminal and voltage test terminal.

2.7.7.5 Pilot and Indicating Lights
Provide transformer, resistor, or diode type.

2.7.7.6 Lightning Arrester
Shall conform to JIS C 4608.

2.7.7.7 Insulators
Shall conform to JIS C 3814, and JIS C 3851.

2.7.7.8 EMCS Terminal
Provide plywood (600 mm x 600mm x 12mm) with terminal blocks, receptacle outlet and associated wiring as indicated on drawings.

2.7.7.9 Space Heater
As indicated on drawings.

2.7.7.10 Receptacles
Provide receptacle outlet for maintenance.
Shall conform to JIS C 8303, grounding-type and duplex type.

2.7.7.11 LED Lighting Fixtures

Provide LED lighting fixtures inside cabinet.
Shall conform to JIS C 8106, JIS C 8105-1 and JIS C 8105-2-2.

2.7.7.12 Roof Fan

As indicated on drawings.

2.7.7.12.1 Air Intake Fan

Provide Air Intake Fan on side wall of receiving panel. Its cover (outdoor hood) shall have minimum 500mm straight portion duct below lower portion of opening for air intake on side wall. Straight portion duct shall be opened forward downside, and opening of duct shall be covered by crimped wire cloth and woven wire cloth with stainless steel (SUS304) frame. Wire clothes shall be fixed to cover by bolts or screws. Requirements for wire clothes are as follows, and their layer shall be following order from downside (outside);

1. Crimped wire cloth, JIS G 3553, CR-S (SUS304), Wire dia. 1.6mm, mesh size 9mm
2. Woven wire cloth, JIS G 3555, PW-S (SUS304), Wire dia. 0.65mm, 8 mesh
3. Woven wire cloth, JIS G 3555 PW-S (SUS304), Wire dia. 0.65mm, 10 mesh

2.8 WIRE AND CABLES

2.8.1 Current Carrying Section

2.8.1.1 Cable Head

Cable head shall be designed for terminating one single conductor cables per phase and shall be arranged for conduits entering from below. Cable head Shall conform to JCAA C 3102.

2.8.1.2 Bus Duct (Busway)

JIS C 8364.

2.8.1.3 Copper Bus Bars

Shall conform to JIS H 3140.

2.8.1.4 Copper Ground Bus Terminal (Copper Bus Bar for Ground Terminal)

Provide a copper ground bus terminal of sufficient amperage and install. Bus bars shall be JIS H 3140.

2.8.1.5 Terminal Blocks

JIS C 8201-7-1.

[2.8.1.6 Extra-High-Voltage Cable (Over 6.6 kV)

Provide as specified in SECTION 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
High voltage wire for cubicle type unit substation shall conform to JIS C 3611, Type KIP.

Provide as specified in SECTION 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Provide as specified in SECTION 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of JIS C 0920 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Gray[ Dark Gray]. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

Provide standard factory finishes including rust inhibiting treatment. Unless otherwise specified or indicated finish of outside panels shall be applied factory finish color. Field applied paint shall not be permitted for newly installed panels. The cabinet shall include likely panelboard, power panel, control panel, breaker box, disconnecting switch box, terminal box and steel cabinet for electrical work.

Provide standard factory finishes including rust inhibiting treatment, except that the inside finish of the cabinet shall be vivid orange (2.5YR5/12 of JIS Z 8721) and the outside including exposed parts of trim and door shall be clear blue (2.5PB5/8 of JIS Z 8721).

Provide standard factory finishes including rust inhibiting treatment, except that the inside finish of the cabinet shall be vivid orange (2.5YR5/12 of JIS Z 8721) and the outside including exposed parts of trim and door shall be sand beige (2.5Y8.5/1 of JIS Z 8721).
2.10.2.3 Surrounding

Provide standard factory finishes including rust inhibiting treatment, except that the inside finish of the cabinet shall be vivid orange (2.5YR5/12 of JIS Z 8721) and the outside including exposed parts of trim and door shall match to surrounding wall surface.

2.10.2.4 Fire Red

Provide standard factory finishes including rust inhibiting treatment, except that the inside finish of the cabinet shall be vivid orange (No. 2.5YR5/12 of JIS Z 8721) and the outside including exposed parts of trim and door shall be fire red (No. 7.5R4/14 of JIS Z 8721).

2.10.2.5 Selection of Colors Outside

Selection of color outside cabinet including exposed parts of trim shall be clear blue in the industrial area and mechanical room, unless otherwise specified or indicated. The color of the cabinet located other area shall match to surrounding or sand beige. [Directed by the Contracting Officer.]

2.10.3 Nameplate

Provide as specified in Section 26 00 00.00 20, BASIC ELECTRICAL MATERIALS AND METHODS.

2.11 LEAD-IN POCKET FOR TEMPORARY CABLE

As indicated on drawings.

2.12 WARNING SIGN

Warning sign shall be attached at the end of this section.

2.13 GROUNDING AND BONDING

[Provide grounding and bonding as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.]

[Provide as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.]

2.14 MATERIALS FOR CONCRETE FOUNDATION

Features and dimension of the concrete foundation shall be as indicated.

2.14.1 Concrete Material

Specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

2.14.2 Anchor Bolt

Anchor bolts shall be JIS B 1178, Type L. Bolts shall be stainless steel material conforming to SUS 304.

2.14.3 Anchor Bolt (Expansion Anchor)

Tubular, multi-slit, internal thread, with stud bolt having a head of the expander shape, as indicated on drawing. Do not use plastic material.
2.14.4 Anchor Bolt (Chemical Anchor)

Shall be a two-part system composed of a threaded rod stud and a sealed glass capsule containing premeasured amounts of epoxy acrylic resin, quartz sand, and a hardener contained in a separate vial within the capsule.

2.14.5 Nuts and Washers

Material shall be stainless steel conforming to SUS 304.

2.15 ADDITIONAL REQUIREMENTS OF THE SUBSTATION SWITCHING STATION SWITCHGEAR

Additional requirements of cubicle type unit substation open type unit substation switching station switchgear shall be attached at the end of this section as a reference.

PART 3 EXECUTION

3.1 INSTALLATION

Unless otherwise indicated, installation shall be performed in accordance with MLIT ESS, MLIT DSKKS and to the requirements specified herein.

3.2 GROUNDING

Provide grounding as indicated, in accordance with [MLIT ESS and MLIT DSKKS, ] [except that grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms].

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in [Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION] [Section 26 20 00 Interior Distribution System]. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Transformer Grounding

Provide separate copper grounding conductors and connect them to [the ground girdle as indicated] [copper ground bus terminal]. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.2.3 Grounding and Bonding Equipment

Provide separate copper grounding conductors and connect them to copper ground bus terminal. Solid bare copper wire shall be JIS C 3102: Stranded bare copper wire shall be JCS 1226, except as indicated or specified otherwise.

3.2.4 Ground Girdle (Loop Ground)

Provide a 60 sqmm bare copper-ground girdle around substation switching station switchgear. Girdle shall be buried 305 mm (one foot) deep and placed 915 mm (3 feet) laterally from the substation enclosure. Connect girdle to enclosure at two opposite places using 60 sqmm copper.
3.2.5 Connections

Make joints in grounding conductors and ground girdle by exothermic weld or compression connector. Exothermic welds and compression connectors shall be installed as specified in [Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION] [Section 26 20 00 Interior Distribution System].

3.2.6 Resistance

[Maximum resistance-to-ground of grounding system shall be as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION.] [Maximum resistance-to-ground of grounding system shall be as specified in Section 26 20 00 Interior Distribution System.]

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect cubicle type unit substations open type unit substations switching station switchgear furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.4 FIELD APPLIED PAINTING

Field paint shall be specified in Section 09 90 00, PAINTS AND COATINGS.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 9 meters apart.

3.6 RESTORATION

Unless otherwise indicated, all existing objects which interfere with new work shall be removed temporary and reinstalled upon completion of new work.

3.7 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Foundation shall be in accordance with MLIT ESS.

3.7.1 Cast-in-place concrete

Cast-in-place concrete work shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.7.2 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.8 FIELD QUALITY CONTROL

3.8.1 Testing Methods for Each Field Test

Use design documents and requirements specified in this section to develop test procedures. Procedures shall consist of detailed instructions for a test setup, execution, and evaluation of test results.
Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test procedures as specified.

3.8.2 Performance of Acceptance Checks and Tests

First Class Construction Electric Management Engineer (1 Kyu Dekikouji Sekou Kanrigishii) shall perform acceptance checks and testing in accordance with the manufacturer's recommendations, and include [the following] visual and mechanical inspections and electrical tests, performed in accordance with Denki Hoan Kyoukai standards, MLIT ESS and MLIT DSKKS.

a. Protection co-ordination curve line

b. Insulation resistance test

c. Withstand voltage test

d. Protective relays test

e. [Leakage current test of transformer]

f. System test

[Grounding system test are performed in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests.]

3.8.3 Equipment Checks and Tests

3.8.3.1 Interrupter Switches

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Verify appropriate anchorage and required area clearances.

(5) Verify appropriate equipment grounding.

(6) Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.

(7) [Verify that fuse sizes and types correspond to approved shop drawings.]

(8) [Verify that each fuse holder has adequate mechanical support.]

(9) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic surveying[ is not][ is]required.

(10) Test interlocking systems for correct operation and
sequencing.

(11) Verify correct phase barrier materials and installation.

(12) Compare switch blade clearances with industry standards.

(13) Inspect all indicating devices for correct operation

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform over-potential tests.

(3) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(4) Measure closed contact-resistance across each switch blade and fuse holder.

(5) Measure fuse resistance.

(6) Verify heater operation.

3.8.3.2 Interrupter Switchgear (LDS, LBS)

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Verify appropriate anchorage and required area clearances.

(5) Verify appropriate equipment grounding.

(6) Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.

(7) Verify that fuse sizes and types correspond to approved shop drawings.

(8) [Verify that each fuse holder has adequate mechanical support.]

(9) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(10) Test interlocking systems for correct operation and sequencing.

(11) Verify correct phase barrier materials and installation.
(12) Compare switch blade clearances with industry standards.

(13) Inspect all indicating devices for correct operation.

b. Electrical Tests

(1) Perform insulation-resistance tests.

(2) Perform over-potential tests.

(3) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(4) Measure closed contact-resistance across each switch blade and fuse holder.

(5) Measure fuse resistance.

(6) Verify heater operation.

3.8.3.3 Vacuum Circuit Breaker (VCB)

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Inspect anchorage, alignment, and grounding.

(5) Perform all mechanical operational tests on both the circuit breaker and its operating mechanism.

(6) Measure critical distances such as contact gap as recommended by manufacturer.

(7) Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

(8) Record as-found and as-left operation counter readings.

b. Electrical Tests

(1) Perform a contact-resistance test.

(2) Verify trip, close, trip-free, and antipump function.

(3) Trip circuit breaker by operation of each protective device.

(4) Perform insulation-resistance tests.

(5) Perform vacuum bottle integrity (overpotential) test across each bottle with the breaker in the open position in strict accordance with manufacturer's instructions. Do not exceed
maximum voltage stipulated for this test.

3.8.3.4 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Verify accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Verify that current transformer[ and voltage transformer] secondary circuits are intact.

3.8.3.5 Switchgear Assemblies

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical, electrical, and mechanical condition.

(3) Confirm correct application of manufacturer's recommended lubricants.

(4) Verify appropriate anchorage, required area clearances, and correct alignment.

(5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

(6) Verify that[ fuse and] circuit breaker sizes and types correspond to approved shop drawings.

(7) [Verify that current and potential transformer ratios correspond to approved shop drawings.]

(8) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method. Thermographic survey[ is not][ is] required.

(9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(10) Clean switchgear.
(11) Inspect insulators for evidence of physical damage or contaminated surfaces.

(12) Verify correct barrier[ and shutter] installation[ and operation].

(13) Exercise all active components.

(14) Inspect all mechanical indicating devices for correct operation.

(15) Verify that vents are clear.

(16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

(17) Inspect control power transformers.

b. Electrical Tests

(1) Perform insulation-resistance tests on each bus section.

(2) Perform overpotential tests.

(3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.

(4) Perform control wiring performance test.

(5) Perform primary current injection tests on the entire current circuit in each section of assembly.

(6) [Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.]

(7) Verify operation of heaters.

3.8.3.6 Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate information with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(4) Verify correct liquid level in tanks.

(5) Perform specific inspections and mechanical tests as recommended by manufacturer.

(6) Verify correct equipment grounding.
(7) Verify the presence of transformer surge arresters.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Verify that the tap-changer is set at specified ratio.

(3) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

(4) Perform transformer test in accordance with JEC 2200 and the transformer manufacture's written instruction.

3.8.3.7 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary circuits and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that required grounding and shorting connections provide good contact.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance test.

(3) Perform a polarity test.

(4) Perform a ratio-verification test.

3.8.3.8 [Kilowatt Demand Meter][Watthour Meter]

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.
b. Electrical tests

(1) [Calibrate watthour meters according to manufacturer's published data.]

(2) Verify that correct multiplier has been placed on face of meter, where applicable.

(3) Verify that current transformer secondary circuits are intact.

3.8.3.9 Grounding System

a. Visual and mechanical inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

(1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete (not exceed 5 ohms). On systems consisting of a single ground rod perform tests before any wire is connected (not exceed 25 ohms). Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod (not exceed 25 ohms) and grounding system (not exceed 5 ohms), indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.8.4 Follow-Up Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days advance notice of the dates and times of checking and testing.
INSERT 7 DRAWINGS

-- End of Section --
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1. REGULATION

MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT:

(1) ARCHITECTURAL EQUIPMENT DESIGN STANDARD
(2) PUBLIC ARCHITECTURAL EQUIPMENT CONSTRUCTION SPECIFICATIONS (ELECTRIC CONSTRUCTION)
(3) PUBLIC ARCHITECTURAL EQUIPMENT CONSTRUCTION STANDARD DRAWING (ELECTRIC CONSTRUCTION)

JAPANESE INDUSTRIAL STANDARDS:

C 4620 CUBICLE TYPE HIGH VOLTAGE POWER RECEIVING UNIT

2. CABINET

THE MAIN MATERIAL THAT COMPOSES THE CABINET DEPENDS ON THE FOLLOWING.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>THICKNESS (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIDE</td>
<td>2.3 2.3</td>
</tr>
<tr>
<td>BOTTOM</td>
<td>3.2 3.2</td>
</tr>
<tr>
<td>ROOF</td>
<td>2.3 2.3</td>
</tr>
<tr>
<td>DOOR</td>
<td>2.3 2.3</td>
</tr>
<tr>
<td>DIVIDER</td>
<td>1.6 1.6</td>
</tr>
<tr>
<td>FRAME</td>
<td>L500x500x46</td>
</tr>
<tr>
<td>BASE</td>
<td>□ 100x50x15</td>
</tr>
</tbody>
</table>

[REMARKS]

1) THE DIVIDER PLATE IS USED AS A PARTITION IN THE SWITCHBOARD.
2) THE DOOR CAN BE LOCKED. AND, AN OPEN DOOR CAN BE FIXED WITH THE STOPPER.
3) MAKE EDGE OF THE DOOR "L" OR "U" BENDING.
4) SLOPE A ROOF OF OUTDOORS TYPE, AND IT IS INCLINE 1/30.
5) THE DIVIDER PLATE IS INSTALLED BETWEEN LOW VOLTAGE TO HIGH-VOLTAGE, BETWEEN HIGH VOLTAGE TO HIGH-VOLTAGE.
### 3. COLOR

<table>
<thead>
<tr>
<th>BUILDING CATEGORY</th>
<th>FACTORY AND WAREHOUSE</th>
<th>OFFICE</th>
<th>HOUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OUTDOOR</td>
<td>INDOOR</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFFICE</td>
<td>SERVICE ROOM</td>
</tr>
<tr>
<td>1. UNIT SUBSTATION, SWITCHING STATION, SWITCHGEAR</td>
<td>①</td>
<td>-</td>
<td>②</td>
</tr>
<tr>
<td>2. PANEL BOARD, POWER PANEL, CONTROL PANEL</td>
<td>③</td>
<td>③</td>
<td>③</td>
</tr>
<tr>
<td>3. COMMUNICATION PANEL (TEL, PA)</td>
<td>③</td>
<td>③</td>
<td>③</td>
</tr>
<tr>
<td>4. FIRE ALARM PANEL</td>
<td>③</td>
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</table>

<table>
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<tr>
<th></th>
<th>OFFICE</th>
<th>SERVICE ROOM</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>-</td>
<td>②</td>
</tr>
<tr>
<td>2.</td>
<td>③</td>
<td>③</td>
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<tr>
<td>3.</td>
<td>③</td>
<td>③</td>
</tr>
<tr>
<td>4.</td>
<td>③</td>
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<table>
<thead>
<tr>
<th></th>
<th>OFFICE</th>
<th>DINING PASSAGE</th>
<th>SERVICE ROOM</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>-</td>
<td>-</td>
<td>②</td>
</tr>
<tr>
<td>2.</td>
<td>③</td>
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<td>3.</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>COMMON SPACE</th>
<th>LOBBY PASSAGE</th>
<th>DWELLI NG ROOF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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<td>-</td>
<td>②</td>
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<tr>
<td>2.</td>
<td>③</td>
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<tr>
<td>3.</td>
<td>③</td>
<td>③</td>
<td>③</td>
</tr>
<tr>
<td>4.</td>
<td>③</td>
<td>③</td>
<td>③</td>
</tr>
</tbody>
</table>

INSIDE FINISH OF THE CABINET: ⑥

1. : 2.5PB 5/8 (Blue)
2. : 10YR 8/2 (Beige/Deep)
3. : 2.5Y 8.5/1 (Beige/Middle)
4. : 2.5Y 9/1 (Beige/Pale)
5. : 7.5R 4/14 (Red)
6. : 2.5YR/12 (Vivid Orange)
[REMARKS]

1) ADDITIONAL REQUIREMENTS OF FINISH COLORS AND COATS SHALL BE DETERMINED BY THE GOVERNMENT DUE TO CONCERNING OF ENVIRONMENT, AND AREA REQUIREMENTS.

2) CONDUITS AND BOXES SHALL BE SAME OR VERY SIMILAR COLOR TO THE SURFACE OF THE BUILDING, FACILITY, AND EQUIPMENT, TO BE INSTALLED.

3) THIS TABLE IS SHOWN A BASIC CONCEPT OF FIELD PAINTING UNLESS SPECIFIED OR INDICATED.

4) FACTORY FINISH COLOR FOR CUBICLE ENCLOSURE SHALL BE APPROVED BY THE UTILITY DEPARTMENT, PRY 32, PRIOR TO APPLICATION.

5) CABINETS TO BE PROVIDED IN BUILDING SERVICE ROOMS, MECHANICAL ROOMS, SWITCH ROOMS, SHALL HAVE FACTORY-FINISHED SALT-AIR-PROOF COATING, (TAIEN-TOSOU).

6) CABINETS TO BE PROVIDED OUT OF BUILDINGS, SHALL HAVE FACTORY-FINISHED SALT-AIR-PROOF COATING, HEAVY-DUTY TYPE, (HU-TAIEN-TOSOU).

7) ALL OF THE FACTORY-FINISH COLORS SHALL BE HALF MAT FINISH.

4. STANDARD HANDLE

KEY No A-312-1-3, HL-60, 40, 30
5. NAME PLATE

THE NAME PLATE FOR PANELBOARD AND THE NAME PLATE FOR OPERATION DEPEND ON THE FOLLOWING. (JIS Z 8304)

① NAME PLATE FOR PANELBOARD (INDOOR: ATTACH NYLON RIVET, OUTDOOR: ATTACH SCREW) (G-2) JEM 1172 (SCALE: 1/5)

② NAME PLATE FOR OPERATION (NOTE: A AND B TYPE, ONLY THE RIGHT SIDE IS THE ELONGATE HOLE)

<table>
<thead>
<tr>
<th>STICKING</th>
<th>ATTACH NYLON RIVET OR SCREW</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>W</td>
</tr>
<tr>
<td>A-1</td>
<td>40</td>
</tr>
<tr>
<td>B-1</td>
<td>50</td>
</tr>
<tr>
<td>C-1</td>
<td>100</td>
</tr>
<tr>
<td>D-1</td>
<td>150</td>
</tr>
<tr>
<td>E-1</td>
<td>200</td>
</tr>
</tbody>
</table>

MATERIAL: TRANSPARENCY ACRYLIC RESIN, GROUND COLOR: MILK-WHITE
FONT: ROUND GOTHIC (SCULPTURE FROM THE BACK)
CHARACTER COLOR: BLACK OR RED
### Additional Requirement

#### 3. Card Folder (Scale: 1/2)
- CH-P2
- CH-A2

- **Material:** ABS resin with form of signing name

#### 4. Panelboard Type Name Plate (Attach Screw) (Scale: 1/2)
- **Installation Hole:** 4-φ3.5
- **Dimensions:**
  - Date of Manufacture
  - Site inspection day or company inspection day,
  - (EX.) Apr. 2001

#### 5. Manufacturer Name Plate (Attach Screw) (Scale: 1/1)
- **Installation Hole:** 2-φ3.3
- **Dimensions:**
  - Order No.
  - Made:
  - XXXX XXXX ELEC. CO., LTD.

- **Material:** Aluminum (to. 5)
- **Ground Color:** Aluminum ground color
- **Font:** Round Gothic
- **Character Color:** Black
### Additional Requirement

<table>
<thead>
<tr>
<th>Munsell Color</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>N-1.0</td>
</tr>
<tr>
<td>B</td>
<td>N-9.5</td>
</tr>
<tr>
<td>C</td>
<td>5R7/13</td>
</tr>
</tbody>
</table>

**Material:** Aluminum

**Processing:** PhotoPrint and CRIARACAR Finish

### CAUTION POINTER (SCALE: 1/2) (PHOTOPRINT)

**Font:** Futura Bold

**Color:** Red

**Material:** Colorless Transparency Vinyl Chloride

**Dimensions:**
- 260 mm (Width)
- 80 mm (Height)
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1.3 DEFINITIONS
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   1.4.1 Government Submittal Review
   1.4.2 Reduced Submittal Requirements
1.5 QUALITY ASSURANCE
   1.5.1 Pad-Mounted Transformer Drawings
   1.5.2 Regulatory Requirements
   1.5.3 Standard Products
      1.5.3.1 Alternative Qualifications
      1.5.3.2 Material and Equipment Manufacturing Date
1.6 MAINTENANCE
   1.6.1 Additions to Operation and Maintenance Data

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      2.2.1.1 High Voltage, Dead-Front
      2.2.1.2 High Voltage, Live-Front
      2.2.1.3 Low Voltage
   2.2.2 Transformer
      2.2.2.1 Specified Transformer Efficiencies
   2.2.3 Insulating Liquid
      2.2.3.1 Liquid-Filled Transformer Nameplates
   2.2.4 Corrosion Protection
2.3 WARNING SIGNS AND LABELS
2.4 ARC FLASH WARNING LABEL
2.5 GROUNDING AND BONDING
2.6 PADLOCKS
2.7 CAST-IN-PLACE CONCRETE
2.8 SOURCE QUALITY CONTROL
   2.8.1 Transformer Test Schedule
   2.8.2 Design Tests
   2.8.3 Routine and Other Tests

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3.2 GROUNDING
   3.2.1 Grounding Electrodes
   3.2.2 Pad-Mounted Transformer Grounding
3.2.3 Connections
3.2.4 Grounding and Bonding Equipment
3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES
  3.3.1 Meters and Current Transformers
3.4 FIELD APPLIED PAINTING
3.5 WARNING SIGN MOUNTING
3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES
  3.6.1 Cast-In-Place Concrete
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3.7 FIELD QUALITY CONTROL
  3.7.1 Performance of Acceptance Checks and Tests
    3.7.1.1 Pad-Mounted Transformers
    3.7.1.2 Current Transformers
    3.7.1.3 Watthour Meter
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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS) or Japan Architectural Standard Specification (JASS) for non-Japanese standards, as approved by the Contracting Officer's representative.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1  ((2014; Errata 2016) Electric Meters - Code for Electricity Metering

ASTM INTERNATIONAL (ASTM)


ASTM D1535  (2014; R 2018) Standard Practice for Specifying Color by the Munsell System


ASTM D92  (2012a) Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D97  (2017b) Standard Test Method for Pour Point of Petroleum Products

FM GLOBAL (FM)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 386 (2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV


IEEE C37.47 (2011) Standard for High Voltage Distribution Class Current-Limiting Type Fuses and Fuse Disconnecting Switches

IEEE C57.12.00 (2015) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers


IEEE C57.12.34 (2015) Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below


IEEE C57.13 (2016) Requirements for Instrument Transformers


INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

JAPAN ELECTRICAL SAFETY INSPECTION ASSOCIATIONS

Denki Hoan Kyoukai
Japan Standard for Acceptance Testing and Inspections

MINISTRY OF LAND, INFRASTRUCTURE AND TRANSPORT JAPAN (MLIT)

MLIT DSKKS
Denki Setsubi Kouji Kanri Shishin (DSKKS)
Electrical Construction Supervision Guidelines

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS C 0365

JIS C 60364-5-54

JIS Z 9101

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.7
(2014) Requirements for Watthour Meter Sockets

NEMA 260
(1996; R 2004) Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas

NEMA LI 1
(1998; R 2011) Industrial Laminating Thermosetting Products

NEMA Z535.4
(2011; R 2017) Product Safety Signs and Labels

NEMA/ANSI C12.10
(2011) Physical Aspects of Watthour Meters - Safety Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70
(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14; TIA 17-15; TIA 17-16; TIA 17-17 ) National Electrical Code

NFPA 70E
(2018; TIA 18-1; TIA 81-2) Standard for Electrical Safety in the Workplace
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203 (1992) Fish Acute Toxicity Test

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)


U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431 Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467 (2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Pad-mounted Transformer Drawings; G[,] [______]

SD-03 Product Data
   Pad-mounted Transformers; G

SD-06 Test Reports
   Acceptance Checks and Tests;

SD-07 Certificates
Transformer Efficiencies;
SD-10 Operation and Maintenance Data
Transformer(s), Data Package 5;

[1.4.1 Government Submittal Review

[Code CI44, NAVFAC LANT, Naval Facilities Engineering Command][_____] will
review and approve all submittals in this section requiring Government
approval.

]1.4.2 Reduced Submittal Requirements

Transformers designed and manufactured by ABB in Jefferson City, MO; by
Easton's Cooper Power Series Transformers in Waukesha, WI; by ERMCO in
Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the
entire submittal package requirements of this contract. Instead, submit
the following items:

a. A certification, signed by the manufacturer, stating that the
manufacturer will meet the technical requirements of this specification.

b. An outline drawing of the transformer with devices identified
(paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item a).

c. ANSI nameplate data of the transformer (paragraph PAD-MOUNTED
TRANSFORMER DRAWINGS, item b).

[ d. Manufacturer's published time-current curves in PDF format and in
electronic format suitable for import or updating into the [EasyPower]
SKM PowerTools for Windows] [_____] computer program of the
transformer high side fuses (paragraph PAD-MOUNTED TRANSFORMER
DRAWINGS, item e).

] e. Provide transformer test schedule and routine and other tests required
by submittal item "SD-09 Manufacturer's Field Reports".

f. Provide acceptance test reports required by submittal item "SD-06 Test
Reports".

g. Provide operation and maintenance manuals required by submittal item
"SD-10 Operation and Maintenance Data".

1.5 QUALITY ASSURANCE

1.5.1 Pad-Mounted Transformer Drawings

Include the following as a minimum:

a. An outline drawing, including front, top, and side views.

b. IEEE nameplate data.

c. Elementary diagrams and wiring diagrams[ with terminals identified of
watthour meter and current transformers].

d. One-line diagram, including switch(es)[, current transformers, meters,
[ e. Manufacturer's published time-current curves in PDF format and in electronic format suitable for import or updating into the [EasyPower] [SKM PowerTools for Windows] [_____] computer program of the transformer high side fuses.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, except of NFPA 70 when more stringent requirements are specified or indicated, as though the word "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

a. An instruction manual with pertinent items and information highlighted
b. An outline drawing, front, top, and side views

c. Prices for spare parts and supply list

d. Routine and field acceptance test reports

e. Fuse curves for primary fuses

[f. Information on watthour demand meter, CT's, and fuse block

]g. Actual nameplate diagram

h. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in [Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION,][ Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM,][ and] Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein. Submit manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

2.2.1 Compartments

Provide high- and low-voltage compartments separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment contains: the incoming line, insulated high-voltage [load-break ] [dead-break ] connectors, [bushing well inserts,][ feed-thru inserts,] six high-voltage [bushing wells][one-piece bushings] configured for loop feed application, load-break switch handle(s), [access to oil-immersed bayonet fuses,][ dead-front surge arresters,] tap changer handle, connector parking stands[ with insulated standoff bushings],[ protective caps,] and ground pad.

[ Minimum high-voltage compartment dimensions: IEEE C57.12.34, Figures 16 and 17.

][a. Insulated high-voltage load-break connectors: IEEE 386, rated [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector must have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

][b. Insulated high-voltage dead-break connectors: IEEE 386, rated [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Current rating: 600 amperes rms continuous. Short time rating: 25,000 amperes rms
symmetrical for a time duration of 0.17 seconds. Connector must have a [200 ampere bushing interface for surge arresters,] steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

c. Bushing well inserts[ and feed-thru inserts]: IEEE 386, 200 amperes, [15][25] kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.[ Provide feed-thru inserts as indicated.]

d. One-piece bushings: IEEE 386, [200][600] amperes, [15][25][35][_____] kV Class.

e. Load-break switch

Radial-feed two-position oil-immersed type rated at [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL], with a continuous current rating and load-break rating of [200][300][_____] amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch must be rated at [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL], with a continuous current rating and load-break rating of [200][300][_____] amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches must be as follows:

<table>
<thead>
<tr>
<th>ARRANGEMENT NO.</th>
<th>DESCRIPTION OF SWITCH ARRANGEMENT</th>
<th>SWITCH POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LINE A. SW.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OPEN</td>
</tr>
<tr>
<td>1</td>
<td>Line A connected to Line B and both lines connected to transformer</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Transformer connected to Line A only</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Transformer connected to Line B only</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Transformer open and loop closed</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Transformer open and loop open</td>
<td>X</td>
</tr>
</tbody>
</table>

f. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. The bayonet fuse links sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and
current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. Include an oil retention valve inside the bayonet assembly housing, which closes when the fuse holder is removed, and an external drip shield to minimize oil spills. Display a warning label adjacent to the bayonet fuse(s) cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.[ Connect current-limiting fuses ahead of the radial-feed load-break switch.]

[g. Surge arresters: IEEE C62.11, rated [3][6][9][10][12][15][18][21][24][27][30][36][_____] kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap.[ Provide three arresters for radial feed circuits.][ Provide [three][six] arresters for loop feed circuits.]

] h. Parking stands: Provide a parking stand near each bushing.[ Provide insulated standoff bushings for parking of energized high-voltage connectors on parking stands.]

[i. Protective caps: IEEE 386, [200][600] amperes, [15][25][35][_____] kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushings.]

[2.2.1.2 High Voltage, Live-Front

High-voltage compartment contains: the incoming line, transformer high-voltage bushings, load-break switch handle(s),[ access to oil-immersed bayonet fuses],[ surge arresters,] tap changer handle, insulated phase barriers, and ground pad.

a. Cable terminators: Provide as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

b. Load-break switch

[ Radial-feed two-position oil-immersed type rated at [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL], with a continuous current rating and load-break rating of [200][300][_____] amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

][ Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch must be rated at [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL], with a continuous current rating and load-break rating of [200][300][_____] amperes, and a make-and-latch rating of 12,000 rms amperes symmetrical. Locate the switch handles in the high-voltage compartment. Operation of switches must be as follows:
Japan Edited Specifications
February 2020

<table>
<thead>
<tr>
<th>ARRANGEMENT NO.</th>
<th>DESCRIPTION OF SWITCH ARRANGEMENT</th>
<th>SWITCH POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LINE A SW.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OPEN</td>
</tr>
<tr>
<td>1</td>
<td>Line A connected to Line B and both lines connected to transformer</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Transformer connected to Line A only</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Transformer connected to Line B only</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Transformer open and loop closed</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Transformer open and loop open</td>
<td>X</td>
</tr>
</tbody>
</table>

}\[c. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. The bayonet fuse links sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. Include an oil retention valve inside the bayonet assembly housing, which closes when the fuse holder is removed, and an external drip shield to minimize oil spills. Display a warning label adjacent to the bayonet fuse(s) cautioning against removing or inserting fuses unless the transformer has been de-energized and the tank pressure has been released.

Bayonet fuse assembly: 150 kV BIL.

Oil-immersed current-limiting fuses: IEEE C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified.[ Connect current-limiting fuses ahead of the radial-feed load-break switch.]

}\[d. Surge arresters: IEEE C62.11, rated [3][6][9][10][12][15][18][21][24][27][30][36][_____] kV.[ Provide three arresters for radial feed circuits.[ Provide [three][six] arresters for loop feed circuits.]

}] e. Insulated phase barriers: NEMA LI 1, Type GPO-3, 6.35 mm minimum thickness. Provide vertical barriers between the high-voltage bushings and a single horizontal barrier above the high-voltage bushings.

2.2.1.3 Low Voltage

Low-voltage compartment contains: low-voltage bushings with NEMA spade terminals, accessories, metering, stainless steel or laser-etched anodized
aluminum diagrammatic transformer nameplate, and ground pad.

a. Include the following accessories: drain valve with sampler device, fill plug, pressure relief device, liquid level gage, pressure-vacuum gage, and dial type thermometer with maximum temperature indicator.

[b. Metering: Provide as specified in Section [26 27 14.00 20 ELECTRICITY METERING] [26 27 13.10 30 ELECTRIC METERS].

[c. Metering: NEMA/ANSI C12.10. Provide a socket-mounted electronic programmable outdoor watthour meter, surface mounted flush against the side of the low-voltage compartment as indicated. [Metering shall be compliant with the current Advanced Meter Reading System (AMRS) Electric Meter Specifications.] Program the meter at the factory or in the field. When field programming is performed, turn field programming device over to the Contracting Officer at completion of project. Coordinate the meter to system requirements.

(1) Design: Provide meter designed for use on a 3-phase, 4-wire, [200Y/100][208Y/120][440Y/254][420Y/242][480Y/277] volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS) [as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC].

(2) Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

(3) Class: 20; Form: [9S][______]; Accuracy: plus or minus 1.0 percent; Finish: Class II

(4) Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

(5) Kilowatt-hour Register: five digit electronic programmable type

(6) Demand Register:
   (a) Provide solid state
   (b) Meter reading multiplier: Indicate multiplier on the meter face.
   (c) Demand interval length: programmed for [15][30][60] minutes with rolling demand up to six subintervals per interval.

(7) Meter fusing: Provide a fuse block mounted in the secondary compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

(8) Socket: ANSI C12.7. [Meter socket shall be compliant with the current Advanced Meter Reading System (AMRS) Electric Meter Specifications.] Provide NEMA Type 3R, box-mounted socket having automatic circuit-closing bypass and having jaws compatible with requirements of the meter. Cover unused hub openings with blank hub plates. Paint box [Munsell 7GY3.29/1.5 green][Munsell 5BG7.0/0.4 sky gray (ANSI 70)] [______] to match the pad-mounted transformer to which the box-mounted socket is attached. The
Munsell color notation is specified in ASTM D1535.

(9) Current transformers: IEEE C57.13. Provide butyl-molded window type current transformers with 600-volt insulation, 10 kV BIL and mount on the low-voltage bushings. Route current transformer leads in a location as remote as possible from the power transformer secondary cables to permit current measurements to be taken with hook-on-ammeters. Provide three current transformers per power transformer with characteristics listed in the following table.

<table>
<thead>
<tr>
<th>kVA</th>
<th>Sec. Volt</th>
<th>CT Ratio</th>
<th>RF</th>
<th>Meter Acc. Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>[500]</td>
<td>[208Y/120]</td>
<td>[1200/5]</td>
<td>[1.5]</td>
<td>[0.3 thru B-0.5]</td>
</tr>
<tr>
<td>[750]</td>
<td>[480Y/277]</td>
<td>[ 800/5]</td>
<td>[2.0]</td>
<td>[0.3 thru B-0.5]</td>
</tr>
</tbody>
</table>

]2.2.2 Transformer

a. Less-flammable [bio-based] liquid-insulated[ or oil-insulated], two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer rated [_____] kVA.

c. Transformer voltage ratings: [_____] V [Delta][_____] - [_____] V [GrdY][_____] [For GrdY - GrdY transformers, provide transformer with five-legged core design for third harmonic suppression.]

d. Tap changer: externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Indicate which tap setting is in use, clearly visible when the compartment is opened.

e. Minimum tested percent impedance at 85 degrees C:

   2.50 for units rated 75kVA and below
   2.87 for units rated 112.5kVA to 300kVA
   4.03 for 500kVA rated units
   5.32 for units rated 750kVA and above

f. Comply with the following audible sound level limits:

<table>
<thead>
<tr>
<th>kVA</th>
<th>DECIBELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>51</td>
</tr>
<tr>
<td>112.5</td>
<td>55</td>
</tr>
<tr>
<td>150</td>
<td>55</td>
</tr>
<tr>
<td>225</td>
<td>55</td>
</tr>
</tbody>
</table>
g. Include:

(1) Lifting lugs and provisions for jacking under base, with base construction suitable for using rollers or skidding in any direction.

(2) An insulated low-voltage neutral bushing with NEMA spade terminal, and with removable ground strap.

(3) Provide transformer top with an access handhole.

(4) kVA rating conspicuously displayed [using 75 mm high yellow letters] on its enclosure.

2.2.2.1 Specified Transformer Efficiencies

Provide transformer efficiency calculations utilizing the actual no-load and load loss values obtained during the routine tests performed on the actual transformer(s) prepared for this project. Reference no-load losses (NLL) at 20 degrees C. Reference load losses (LL) at 55 degrees C and at 50 percent of the nameplate load. The transformer is not acceptable if the calculated transformer efficiency is less than the efficiency indicated in the "KVA / Efficiency" table below. The table is based on requirements contained within 10 CFR 431, Subpart K. Submit certification, including supporting calculations, from the manufacturer indicating conformance.

<table>
<thead>
<tr>
<th>kVA</th>
<th>EFFICIENCY (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>98.65</td>
</tr>
<tr>
<td>30</td>
<td>98.83</td>
</tr>
<tr>
<td>45</td>
<td>98.92</td>
</tr>
<tr>
<td>75</td>
<td>99.03</td>
</tr>
<tr>
<td>112.5</td>
<td>99.11</td>
</tr>
<tr>
<td>150</td>
<td>99.16</td>
</tr>
</tbody>
</table>
2.2.3 Insulating Liquid

a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for
less-flammable liquids having a fire point not less than 300 degrees C
tested per ASTM D92 and a dielectric strength not less than 33 kV
tested per ASTM D877/D877M. Provide identification of transformer as
"non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

Provide a fluid that is a biodegradable, electrical insulating, and
cooling liquid classified by UL and approved by FM as "less flammable"
with the following properties:

(1) Pour point: ASTM D97, less than -15 degree C

(2) Aquatic biodegradation: EPA 712-C-98-075, ultimately
biodegradable as designated by EPA.

(3) Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012,
pass

[ b. Mineral oil: ASTM D3487, Type II, tested in accordance with ASTM D117.
Provide identification of transformer as "non-PCB" and "Type II mineral
oil" on the nameplate.

]2.2.3.1 Liquid-Filled Transformer Nameplates

Provide nameplate information in accordance with IEEE C57.12.00 and as
modified or supplemented by this section. Include the following information
on the transformer nameplate: "PCB CONTENT LESS THAN 0.1 PPM AT TIME OF
MANUFACTURE."

2.2.4 Corrosion Protection

Provide corrosion resistant bases and cabinets of transformers, fabricated
of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Base
includes any part of pad-mounted transformer that is within 75 mm of
concrete pad.
Provide entire transformer assembly, including tank and radiator, base, enclosure, and metering enclosure fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Form enclosure of stainless steel sheets. The optional use of aluminum is permitted for the metering enclosure.

Paint entire transformer assembly [Munsell 7GY3.29/1.5 green][Munsell 5BG7.0/0.4 sky gray (ANSI 70)][______], with paint coating system complying with IEEE C57.12.28 [and IEEE C57.12.29] regardless of base, cabinet, and tank material. The Munsell color notation is specified in ASTM D1535.

2.3 WARNING SIGNS AND LABELS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts in accordance with NEMA Z535.4 and NEMA 260.

a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning labels (decals, Panduit No. PPSO710D72 or approved equal) on the outside of the high voltage compartment door(s) with nominal dimensions of 178 by 255 mm with the legend "WARNING HIGH VOLTAGE" printed in two lines of nominal 50 mm high letters. Include the work "WARNING" in white letters on an orange background and the words "HIGH VOLTAGE" in black letters on a white background.

b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 355 by 255 mm with the legend "WARNING HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 75 mm high white letters on an orange and black field.

2.4 ARC FLASH WARNING LABEL

Provide warning label of potential electrical arc flash hazards for the enclosure of pad-mounted transformers in accordance with NFPA 70E or JIS Z 9101.

2.5 GROUNDING AND BONDING

UL 467 or JIS C 60364-5-54. Provide grounding and bonding as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 PADLOCKS

Provide padlocks for pad-mounted equipment [and for each fence gate], keyed alike [as directed by the Contracting Officer]. Comply with Section 08 71 00 DOOR HARDWARE.

2.7 CAST-IN-PLACE CONCRETE

Provide concrete associated with electrical work for other than encasement of underground ducts rated for 30 MPA minimum 28-day compressive strength unless specified otherwise. Conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

Provide concrete associated with electrical work as follows:
a. Composed of fine aggregate, coarse aggregate, portland cement, and water so proportioned and mixed as to produce a plastic, workable mixture.

b. Fine aggregate: hard, dense, durable, clean, and uncoated sand.

c. Coarse aggregate: reasonably well graded from 4.75 mm to 25 mm.

d. Fine and coarse aggregates: free from injurious amounts of dirt, vegetable matter, soft fragments or other deleterious substances.

e. Water: fresh, clean, and free from salts, alkali, organic matter, and other impurities.

f. Concrete associated with electrical work for other than encasement of underground ducts: 30 MPa minimum 28-day compressive strength unless specified otherwise.

g. Slump: Less than 100 mm. Retempering of concrete will not be permitted.

h. Exposed, unformed concrete surfaces: smooth, wood float finish.

i. Concrete must be cured for a period of not less than 7 days, and concrete made with high early strength portland cement must be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed by the Contracting Officer.

j. Air entrain concrete exposed to weather using an air-entraining admixture conforming to ASTM C260/C260M.

k. Air content: between 4 and 6 percent.

2.8 SOURCE QUALITY CONTROL

2.8.1 Transformer Test Schedule

The Government reserves the right to witness tests. Provide transformer test schedule for tests to be performed at the manufacturer's test facility. Any/all associated costs related to Government personnel travel to witness testing will be solely at the government's expense. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

a. Test Instrument Calibration

(1) Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

(2) Accuracy: Traceable to the National Institute of Standards and Technology.

(3) Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.

(4) Dated calibration labels: visible on all test equipment.
(5) Calibrating standard: higher accuracy than that of the instrument tested.

(6) Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(a) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(b) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.8.2 Design Tests

IEEE C57.12.00, and IEEE C57.12.90. Section 5.1.2 in IEEE C57.12.80 states that "design tests are made only on representative apparatus of basically the same design." Submit design test reports (complete with test data, explanations, formulas, and results), in the same submittal package as the catalog data and drawings for (each of) the specified transformer(s), with design tests performed prior to the award of this contract.

a. Tests: certified and signed by a registered professional engineer.

b. Temperature rise: "Basically the same design" for the temperature rise test means a pad-mounted transformer with the same coil construction (such as wire wound primary and sheet wound secondary), the same kVA, the same cooling type (KNAN), the same temperature rise rating, and the same insulating liquid as the transformer specified.

c. Lightning impulse: "Basically the same design" for the lightning impulse dielectric test means a pad-mounted transformer with the same BIL, the same coil construction (such as wire wound primary and sheet wound secondary), and a tap changer, if specified. Design lightning impulse tests includes the primary windings only of that transformer.

(1) IEEE C57.12.90, paragraph 10.3 entitled "Lightning Impulse Test Procedures," and IEEE C57.98.

(2) State test voltage levels.

(3) Provide photographs of oscilloscope display waveforms or plots of digitized waveforms with test report.

d. Lifting and moving devices: "Basically the same design" requirement for the lifting and moving devices test means a test report confirming that the lifting device being used is capable of handling the weight of the specified transformer in accordance with IEEE C57.12.34.

e. Pressure: "Basically the same design" for the pressure test means a pad-mounted transformer with a tank volume within 30 percent of the tank volume of the transformer specified.

f. Short circuit: "Basically the same design" for the short circuit test means a pad-mounted transformer with the same kVA as the transformer specified.
2.8.3 Routine and Other Tests

IEEE C57.12.00. Routine and other tests: performed in accordance with IEEE C57.12.90 by the manufacturer on each of the actual transformer(s) prepared for this project to ensure that the design performance is maintained in production. Submit test reports, by serial number and receive approval before delivery of equipment to the project site. Required tests and testing sequence as follows:

a. Phase relation
b. Ratio
c. No-load losses (NLL) and excitation current
d. Load losses (LL) and impedance voltage
e. Dielectric
   (1) Impulse
   (2) Applied voltage
   (3) Induced voltage
f. Leak

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, JIS C 0365, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding [25] ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Pad-Mounted Transformer Grounding

Provide a ground ring around the transformer with [60] sqmm bare copper. [Provide four ground rods in the ground ring, one per corner.][ Provide two ground rods in the ground ring at opposite corners.][ Provide one ground rod in the ground ring with the ground rod located in the transformer cabinet.] Install the ground rods at least 3000 mm apart from each other. Provide separate copper grounding conductors and connect them to the ground loop as indicated. When work in addition to that indicated or specified is required to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.
3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 3371 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

UL 467 or JIS C 60364-5-54, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect pad-mounted transformers furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

[3.3.1 Meters and Current Transformers

ANSI C12.1.

3.4 FIELD APPLIED PAINTING

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.5 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 9 meters apart.

3.6 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

Mount transformer on concrete slab as follows:

a. Unless otherwise indicated, provide the slab with dimensions at least 200 mm thick, reinforced with a 152 by 152 mm MW19 by MW19 mesh placed uniformly 100 mm from the top of the slab.

b. Place slab on a 150 mm thick, well-compacted gravel base.

c. Install slab such that top of concrete slab is approximately 100 mm above the finished grade with gradual slope for drainage.

d. Provide edges above grade with 15 mm chamfer.

e. Provide slab of adequate size to project at least 200 mm beyond the equipment.

Stub up conduits, with bushings, 50 mm into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.6.1 Cast-In-Place Concrete

Provide cast-in-place concrete work in accordance with the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.
[3.6.2 Sealing

When the installation is complete, seal all entries into the equipment enclosure with an approved sealing method. Provide seals of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

]3.7 FIELD QUALITY CONTROL

3.7.1 Performance of Acceptance Checks and Tests

A First Class Construction Electric Management Engineer (1 Kyu Dekikouji Sekou Kanrigishi) shall perform acceptance checks and testing in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS or Denki Hoan Kyoukai and MLIT DSKKS. Submit reports, including acceptance criteria and limits for each test in accordance with NETA ATS "Test Values" or Denki Hoan Kyoukai "Test Report".

3.7.1.1 Pad-Mounted Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition. Check for damaged or cracked insulators and leaks.

(3) Inspect anchorage, alignment, and grounding.

(4) Verify the presence of PCB content labeling.

(5) Verify the bushings and transformer interiors are clean.

(6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(7) Verify correct liquid level in tanks and bushings.

(8) Verify that positive pressure is maintained on gas-blanketed transformers.

(9) Perform specific inspections and mechanical tests as recommended by manufacturer.

(10) Verify de-energized tap changer position is left as specified.

[ (11) Verify the presence of transformer surge arresters.

] b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter.

(2) Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.
[109x701](3) Perform insulation-resistance tests, winding-to-winding and each winding-to-ground. Calculate polarization index. Verify that the tap changer is set at the specified ratio.

(4) Perform turns-ratio tests at all tap positions.

(5) Perform insulation power-factor or dissipation-factor tests on all windings in accordance with test equipment manufacturer’s published data.

(6) Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/capacitance tap. In the absence of a power-factor/capacitance tap, perform hot-collar tests.

(7) Measure the resistance of each high-voltage winding in each de-energized tap-changer position. Measure the resistance of each low-voltage winding in each de-energized tap-changer position, if applicable.

(8) Remove and test a sample of insulating liquid for the following: Dielectric breakdown voltage, Acid neutralization number, Specific gravity, Interfacial tension, Color, Visual Condition, Water in insulating liquids (Required on 25 kV or higher voltages and on all silicone-filled units.), and Power factor or dissipation factor.

(9) Perform dissolved-gas analysis (DGA) on a sample of insulating liquid.

][3.7.1.2 Current Transformers

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit wiring.

(5) Verify the unit is clean.

(6) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(7) Verify that all required grounding and shorting connections provide good contact.

(8) Verify correct operation of transformer withdrawal mechanism and grounding operation.

(9) Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
b. Electrical tests
   (1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
   (2) Perform insulation-resistance test.
   (3) Perform a polarity test.
   (4) Perform a ratio-verification test.

][3.7.1.3 Watthour Meter
   a. Visual and mechanical inspection
      (1) Compare equipment nameplate data with specifications and approved shop drawings.
      (2) Inspect physical and mechanical condition.
      (3) Verify tightness of electrical connections.
   b. Electrical tests
      (1) Calibrate watthour meters according to manufacturer's published data.
      (2) Verify that correct multiplier has been placed on face of meter, where applicable.
      (3) Verify that current transformer secondary circuits are intact.

]3.7.1.4 Grounding System
   a. Visual and mechanical inspection
      (1) Inspect ground system for compliance with contract plans and specifications.
   b. Electrical tests
      (1) Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.
      (2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

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[3.7.1.5 Surge Arresters, High- and Extra-High-Voltage

a. Visual and mechanical inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect anchorage, alignment, grounding, and clearances.

(4) Verify the arresters are clean.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform an insulation-resistance test on each arrester, phase terminal-to-ground.

(3) Test grounding connection.

]3.7.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, notify the Contracting Officer 5 working days in advance of the dates and times of checking and testing.

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1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS), Ministry of Land, Infrastructure and Transport (MLIT), Japan Electrical Safety Inspection Associations, Japanese Electrotechnical Committee (JEC) or Japan Wire Industry Association (JCS) standards for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

JAPANESE ELECTROTECHNICAL COMMITTEE (JEC)

JEC 2200 (2015) Transformer

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS C 1210 (1979) General Rules for Electricity Meters

JIS C 2336 (2012) Pressure-sensitive polyvinyl chloride tapes for electrical purposes

JIS C 2338 (2012) Polyester adhesive tape for electrical insulation

JIS C 2805 (2010) Crimp terminal for copper wire

JIS C 2806 (2003) Bare crimping sleeve for copper wire

JIS C 2810 (1995) General rules on non-separable type wire connectors for interior wiring

JIS C 3101 (1994) Hard-drawn copper wires for electrical purposes

JIS C 3105 (1994) Hard-drawn copper stranded conductors
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**JAPAN WIRE INDUSTRY ASSOCIATION STANDARD (JCS)**

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1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are[ for Contractor Quality Control approval][ for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government]. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00.

SD-02 Shop Drawings

Panelboards; G[, [____]]
Transformers; G[, [____]]
Busway; G[, [____]]
Cable trays; G[, [____]]
Motor control centers; G[, [____]]

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item.
of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices.

Wireways; G[, [_____]]

[Load centers for housing units; G[, [_____]]]

Marking strips drawings; G[, [_____]]

SD-03 Product Data

Receptacles;

Circuit breakers; G[, [_____]]

Switches; G[, [_____]]

Transformers; G[, [_____]]

Enclosed circuit breakers; G[, [_____]]

Motor controllers; G[, [_____]]

[Combination motor controllers; G[, [_____]]]

[Load centers for housing units; G[, [_____]]]

Manual motor starters; G[, [_____]]

[Residential load centers; G[, [_____]]]

[Metering; G[, [_____]]]

[Meter base only; G[, [_____]]]

CATV outlets; G[, [_____]]

Surge protective devices; G[, [_____]]

Include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test;

Grounding system test;

Transformer tests;

Ground-fault receptacle test;

[ SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5;

Metering, Data Package 5;

Submit operation and maintenance data in accordance with Section
QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

a. Single line diagram of the "as-built" building electrical system.
b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 SEISMIC REQUIREMENTS

Provide seismic details[ conforming to[ Section 13 48 00 [SEISMIC] BRACING FOR MISCELLANEOUS EQUIPMENT][ and to][ Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT]][ as indicated].

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL or Japanese standards, where UL or applicable Japanese codes and standards are established for those items for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit or Type G Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit or Type G

JIS C 8305, Type G. Diameter of conduit shall be as indicated.

2.2.2 Rigid Nonmetallic Conduit or Unplasticized Polyvinyl Chloride

JIS C 8430 for Type VE or HIVE conduit of diameter of less than 100mm and JIS K 6741 for Type VP or HIVP conduit diameter or 100mm and larger.

2.2.3 Intermediate Metal Conduit (IMC) or Type C

JIS C 8305, Type C, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT) or Type E Metallic Conduit

JIS C 8305, Type E.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit or Type G, C or E; LL or LT

JIS C 8380.

2.2.6 Flexible Metal Conduit

JIS C 8309.
2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel  
JIS C 8309.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit  
JIS C 8330 and JIS C 8350. Ferrous fittings: cadmium- or zinc-coated in accordance with JIS C 8330 and JIS C 8350.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC or Type G and Type C  
Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT or Type E Conduit  
[Die Cast][Steel][compression][set screw] type.

2.2.8 Fittings for Rigid Nonmetallic Conduit or Unplasticized Polyvinyl Chloride  
JIS C 8432 for diameters less than 100mm and JIS K 6743 for diameters 100mm or larger.

2.2.9 Liquid-Tight Flexible Nonmetallic Conduit or Type PF  
JIS C 8411, Type PF.

2.3 SURFACE RACEWAY

2.3.1 Surface Metal Raceway  
Two-piece painted steel, totally enclosed, snap-cover type. [Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Provide receptacles as specified herein, spaced a minimum of one every [455] [_____] mm.][Wire alternate receptacles on different circuits.]

2.3.2 Surface Nonmetallic Raceway  
JIS C 8425, nonmetallic totally enclosed, snap-cover type. [Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Provide receptacles as specified herein, spaced a minimum of one every [455] [_____] mm.][Wire alternate receptacles on different circuits.]

2.4 BUSWAY  
JIS C 8364. Provide the following:

a. Buses: [copper][or][aluminum].

b. Busways: rated [_____] volts, [_____] continuous current amperes, three-phase,[three-][four-]wire, and include integral or internal[50-percent] ground bus.

c. Short circuit rating: [_____] root mean square (rms) symmetrical amperes minimum][as indicated].

d. Busway systems: suitable for use indoors.
e. Enclosures: [steel][aluminum][metallic].

f. Hardware: plated or otherwise protected to resist corrosion.

g. Joints: one-bolt type with through-bolts, which can be checked for tightness without deenergizing system.

h. Maximum hot spot temperature rise at any point in busway at continuous rated load: do not exceed 55 degrees C above maximum ambient temperature of 40 degrees C in any position.

i. Internal barriers to prevent movement of superheated gases.

j. Coordinate proper voltage phasing of entire bus duct system, for example where busway interfaces with transformers, switchgear, switchboards, motor control centers, and other system components.

2.4.1 Feeder Busways

Provide[ventilated, except that vertical busways within 1830 mm of floors must be unventilated,][unventilated, totally enclosed] low-impedance busway. Provide bus bars fully covered with insulating material, except at stabs. Provide an entirely polarized busway system.

2.4.2 Plug-In Busways

Unventilated type. Provide the following:

a. Plug-in units: [fusible, handle-operated, switch type, horsepower-rated][circuit breaker-type][handle-operated, switch type, equipped with high interrupting-capacity, current-limiting fuses].

b. Bus bars: covered with insulating material throughout, except at joints and other connection points.

c. A hook stick of suitable length for operating plug-in units from the floor.

2.5 CABLE TRAYS

Provide the following:

a. Cable trays: form a wireway system, with a nominal[75][100][150] mm depth[as indicated].

b. Cable trays: constructed of[aluminum][copper-free aluminum][steel that has been zinc-coated after fabrication].

c. Cable trays: include splice and end plates, dropouts, and miscellaneous hardware.

d. Edges, fittings, and hardware: finished free from burrs and sharp edges.

e. Fittings: ensure not less than load-carrying ability of straight tray sections and have manufacturer's minimum standard radius.

f. Radius of bends: [305][610][915] mm.]

Radius of bends: as
2.5.1 Basket-Type Cable Trays

Provide [size as indicated] of nominal [50, 100, 150, 200, 300, 450, 600] mm width and [25, 50, 100] mm depth with maximum wire mesh spacing of 50 by 100 mm.

2.5.2 Trough-Type Cable Trays

Provide [size as indicated] of nominal [150, 305, 455, 610, 760, 915] mm width.

2.5.3 Ladder-Type Cable Trays

Provide [size as indicated] of nominal [150, 305, 455, 610, 760, 915] mm width with maximum rung spacing of [150, 225, 305, 455] mm.

2.5.4 Channel-Type Cable Trays

Provide [size as indicated] of nominal [75, 100, 150] mm width. Provide trays with one-piece construction having slots spaced not more than 115 mm on centers.

2.5.5 Solid Bottom-Type Cable Trays

Provide [size as indicated] of nominal [150, 305, 455, 610, 760, 915] mm width. [Provide solid covers.][Do not provide solid covers.]

2.5.6 Cantilever

Cantilever-type, center-hung cable trays may be provided at the Contractor's option in lieu of other cable tray types specified.

2.6 OPEN TELECOMMUNICATIONS CABLE SUPPORT

2.6.1 Open Top Cable Supports

Provide open top cable supports in accordance with UL 2043. Provide [[galvanized][zinc-coated][stainless] steel]open top cable supports[ as indicated].

2.6.2 Closed Ring Cable Supports

Provide closed ring cable supports in accordance with UL 2043. Provide [[galvanized][zinc-coated][stainless] steel]closed ring cable supports[ as indicated].

2.7 OUTLET BOXES AND COVERS

JIS C 8340, cadmium- or zinc-coated, if ferrous metal. JIS C 8435, if nonmetallic. Rated [IP65 for wet locations] [IP66, 67 or 68 for dust-tight/hazardous locations].

2.7.1 Floor Outlet Boxes

Provide the following:

a. Boxes: [adjustable][nonadjustable] and concrete tight.
b. Each outlet: consisting of[ nonmetallic][ or][ cast-metal] body with threaded openings,[ or sheet-steel body with knockouts] for conduits,[ adjustable ][, ][ brass flange] ring, and cover plate with [19][25][31.75][53.92] mm threaded plug.

c. Telecommunications outlets: consisting of[ surface-mounted, horizontal][ flush], aluminum or stainless steel housing with a receptacle as specified and[ 25 mm bushed side opening][ 19 mm top opening].

d. Receptacle outlets: consisting of[ surface-mounted, horizontal][ flush] aluminum or stainless steel housing with duplex-type receptacle as specified herein.

e. Provide gaskets where necessary to ensure watertight installation.

f. Provide plugs with installation instructions to the Contracting Officer for [5] [_____] percent of outlet boxes for the capping of outlets upon removal of service fittings.

2.7.2 Outlet Boxes for Telecommunications System

Provide the following:

a. Standard type[ 100 mm square by 54 mm deep][ 120 mm square by 54 mm deep].

b. Outlet boxes for wall-mounted telecommunications outlets: 100 by 54 by 54 mm deep.

c. Depth of boxes: large enough to allow manufacturers' recommended conductor bend radii.

d. Outlet boxes for fiber optic telecommunication outlets: include a minimum 10 mm deep single or two gang plaster ring as shown and installed using a minimum 27 mm conduit system.

e. Outlet boxes for handicapped telecommunications station: 100 by 54 by 54 mm deep.

2.7.3 Clock Outlet for Use in Other Than Wired Clock System

Provide the following:

a. Outlet box with plastic cover, where required, and single receptacle with clock outlet plate.

b. Receptacle: recessed sufficiently within box to allow complete insertion of standard cap, flush with plate.

c. Suitable clip or support for hanging clock: secured to top plate.

d. Material and finish of plate: as specified in paragraph DEVICE PLATES of this section.

2.8 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 1640 mL, JIS C 8340, hot-dip, zinc-coated, if sheet
steel. Rated [IP65 for wet locations] [IP66, 67 or 68 for dust-tight/hazardous locations].

2.9 WIREs AND CABLES

Provide wires and cables in accordance applicable requirements of Japanese standards for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.9.1 Conductors

Provide the following:

a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.

b. Conductors 1.25 sqmm and larger diameter: stranded.

c. Conductors 3.2 mm and smaller diameter: solid.

d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.

e. All conductors: [copper.][ Conductors indicated to be 14 sqmm or smaller diameter: copper. Conductors indicated to be 22 sqmm and larger diameter: copper, unless type of conductor material is specifically indicated, or specified, or required by equipment manufacturer.]

2.9.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2.9.1.2 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

a. Branch circuits: 2.0 mm.

b. Class 1 remote-control and signal circuits: 1.6 mm.

c. Class 2 low-energy, remote-control and signal circuits: 1.2 mm.

d. Class 3 low-energy, remote-control, alarm and signal circuits: 0.65 mm.

2.9.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.9.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

a. Grounding conductors: Green.
b. Neutral conductors: White or Gray.

c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.

2.9.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems as follows:

a. [480/277][440/254V][420/242V][208/120 volt], three-phase, four-wire
   (1) Phase A - red
   (2) Phase B - black
   (3) Phase C - blue

b. [480 volt][440 volt][420 volt][220 volt][210 volt][208 volt], three-phase, three-wire
   (1) Phase A - red
   (2) Phase B - black
   (3) Phase C - blue

c. [105/210][120/240] volt, single phase, three-wire:
   (1) Phase A - red
   (2) Phase B - black

[ d. On three-phase, four-wire delta system, high leg: orange, as required.]

2.9.3 Insulation

Unless specified or indicated otherwise, provide power and lighting wires rated for 600-volts,[Type EM-IE conforming to JIS C 3612][ or ][Type EM-CE, EM-CET or EM-ECEQ conforming to JIS C 3605], except that grounding wire may be type TW conforming to JIS C 3612, Type EM-IE; remote-control and signal circuits: Type TW or TF, conforming to JIS C 3401, Type CEV. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.9.4 Bonding Conductors

JIS C 3101, solid bare copper wire for sizes 8 sqmm and smaller diameter; JIS C 3105 and JCS 1226, Class B, stranded bare copper wire for sizes 14 sqmm and larger diameter.

2.9.4.1 Telecommunications Bonding Backbone (TBB)

Provide a copper conductor TBB in accordance with JIS C 60364-5-54 with 14 sqmm minimum size, and sized at 3.3 sqmm per linear meter of conductor length up to a maximum size of 1500 sqmm.[ Provide insulated TBB with insulation as specified in the paragraph INSULATION and meeting the fire
ratings of its pathway.]

2.9.4.2 Bonding Conductor for Telecommunications

Provide a copper conductor Bonding Conductor for Telecommunications between the telecommunications main grounding busbar (TMGB) and the electrical service ground in accordance with JIS C 60364-5-54. Size the bonding conductor for telecommunications the same as the TBB.

[2.9.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, JIS C 3341 and JIS C 3605.

][2.9.6 EM-EEF Cable

JIS C 3605, Type EM-EEF Cable.

][2.9.7 Wire and Cable for 400 Hertz (Hz) Circuits

Insulated copper conductors.

][2.9.8 Metal-Clad Cable

Type MC cable.

][2.9.9 Armored Cable

Type AC cable.

][2.9.10 Mineral-Insulated, Metal-Sheathed Cable

UL listed; Type MI cable. Do not use sheathing containing asbestos fibers.

][2.9.11 Flat Conductor Cable

UL listed; Type FCC.

][2.9.12 Cable Tray Cable or Power Limited Tray Cable

UL listed; type TC or PLTC.

][2.9.13 Cord Sets and Power-Supply Cords

JIS C 8286.

][2.9.14 Polyethylene or Cross-Linked Polyethylene Cable

[Type [CV][CE] conforming to JIS C 3605 for 600V.][Type [CV][CE], conforming to JIS C 3606 for 6.6kV]

2.10 SPLICES AND TERMINATION COMPONENTS

JIS C 2805, JIS C 2806 and JIS C 2810 for wire connectors and JIS C 2336, JIS C 2338 for insulating tapes. Connectors for 5.5 sqmm and smaller diameter wires: insulated, pressure-type in accordance with JIS C 2805, JIS C 2806 and JIS C 2810 or JIS C 2806 (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.
2.11 DEVICE PLATES

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. For nonmetallic boxes and fittings, other suitable plates may be provided.

[ d. Plates on finished walls: nylon or lexan, minimum 0.792 mm wall thickness and same color as receptacle or toggle switch with which they are mounted.

][e. Plates on finished walls: satin finish stainless steel or brushed-finish aluminum, minimum 0.792 mm thick.

]f. Screws: machine-type with countersunk heads in color to match finish of plate.

g. Sectional type device plates are not be permitted.

h. Plates installed in wet locations: gasketed and UL listed for "wet locations."

[ i. Device plates in areas normally accessible to prisoners: brown or ivory finish nylon-device plates rated for high abuse. Test device plates for compliance with JIS C 8340 and JIS C 8435 for physical strength. Attach device plates with spanner head bolts.

]2.12 SWITCHES

2.12.1 Toggle Switches

JIS C 8304, [ single pole][, double pole][, three-way][, and four-way], totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

a. Handles: [ white][ ivory][ brown] thermoplastic.

b. Wiring terminals: screw-type, side-wired[ or of the solderless pressure type having suitable conductor-release arrangement].

c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.

d. Switches: rated quiet-type ac only, [105][120][210][240][120/277] volts, with current rating and number of poles indicated.

2.12.2 Switch with Red Pilot Handle

Provide the following:

a. Pilot lights that are integrally constructed as a part of the switch's handle.
b. Pilot light color: red and illuminate whenever the switch is closed or "on".

c. Pilot lighted switch: rated 20 amps and [105][120] volts or [210][240][277] volts as indicated.

d. The circuit's neutral conductor to each switch with a pilot light.

2.12.3 Breakers Used as Switches

For [100][120]- and [200][277]-Volt fluorescent fixtures, mark breakers "SWD" in accordance with JIS C 8201-2-1. Provide label adjacent to circuit breaker indicating Breaker used as switch.

2.12.4 Disconnect Switches

JIS C 8201-3. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide switches in IP rated enclosure[ as indicated] per JIS C 8462-1.

2.13 FUSES

JIS C 8269-1, JIS C 8269-2. Provide complete set of fuses for each fusible[ switch][ panel][ and control center]. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers[ or other circuit protective devices] for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.13.1 Fuseholders

Provide in accordance with JIS C 8269-1 or JIS C 8269-2.

2.13.2 Cartridge Fuses, Current Limiting Type (Class R)

JIS C 8269-1 or JIS C 8269-2, [Class[ RK-1][ RK-5][ time-delay type]][Fuse System [A][B][C][D][E][F][G][H][I][J][L]]. Provide only Class R associated fuseholders in accordance with JIS C 8269-1 or JIS C 8269-2.

2.14 RECEPTACLES

Provide the following:

a. [JIS C 8303, JIS C 8281-1, hard use (also designated heavy-duty),][JIS C 8303, JIS C 8281-1 and JIS T 1021, hospital grade,] grounding-type.

b. Ratings and configurations: as indicated.

c. Bodies: [ white][ ivory][ brown].

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per JIS C 8462-1.

f. Screw-type, side-wired wiring terminals or of the solderless pressure
type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.14.1 Switched Duplex Receptacles

Provide separate terminals for each ungrounded pole. Top receptacle: switched when installed.

2.14.2 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations" or weather resistant per JIS C 8303. Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, [polycarbonate, UV resistant/stabilized][die-cast metal/aluminum] cover plate.

2.14.3 Ground-Fault Circuit Interrupter Receptacles

Duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.14.4 Special Purpose Receptacles

Receptacles serving [___] are special purpose.[ Provide in ratings indicated.][ ____ configuration, rated [____] amperes, [____] volts.][ Furnish one matching plug with each receptacle.]

2.14.5 Plug

Provide heavy-duty, rubber-covered[ three-][ four-][ or][ five-]wire cord of required size, install plugs thereon, and attach to equipment. Provide UL listed plugs with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Government.

2.14.6 Range Receptacles

[ ] ampere receptacle configuration [as indicated],[ flush mounted for housing units,] rated 50 amperes, [105/210][125/250] volts.[ Furnish one matching plug with each receptacle.]

2.14.7 Dryer Receptacles

Receptacle configuration [as indicated], rated [ ] amperes, [105/210][125/250] volts.[ Furnish one matching plug with each receptacle.]

2.14.8 Tamper-Resistant Receptacles

Provide duplex receptacle with mechanical sliding shutters that prevent the insertion of small objects into its contact slots.

2.15 PANELBOARDS

Provide panelboards in accordance with the following:
[ a. JIS C 8480 and JIS C 8480, JIS C 0920 having a short-circuit current rating\[ as indicated\] of 10,000 amperes symmetrical minimum].

b. Panelboards for use as service disconnecting means: additionally conform to manufacturer's recommendations.


d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.

f. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise.

g. Main breaker: "separately" mounted\[ "above"]\[ or]\[ "below"] branch breakers.

h. Where "space only" is indicated, make provisions for future installation of breakers.

i. Directories: indicate load served by each circuit in panelboard.

j. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).

[k. Provide new directories for existing panels modified by this project as indicated.

] l. Type directories and mount in holder behind transparent protective covering.

[m. Panelboards: listed and labeled for their intended use.

] n. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

][a. JIS C 8480 and JIS C 8480, JIS C 0920.

b. Panelboards for use as service disconnecting: additionally conform to manufacturer's recommendations.


d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated.

f. Directories: indicate load served by each circuit of panelboard.

g. Directories: indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard.
h. Type directories and mount in holder behind transparent protective covering.

i. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.15.1 Enclosure

Provide panelboard enclosure in accordance with the following:

a. JIS C 0920.

b. Cabinets mounted outdoors or flush-mounted: hot-dipped galvanized after fabrication.

c. Cabinets: painted in accordance with paragraph PAINTING.

d. Outdoor cabinets: Weatherproof rated IP code with conduit hubs welded to the cabinet [a removable steel plate 7 mm thick in the bottom for field drilling for conduit connections].

e. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.

f. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 3 mm.

g. Holes: provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 15 mm clear space between the back of the cabinet and the wall surface.

h. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.

i. Each door: fitted with a combined catch and lock, except that doors over 600 mm long provided with a three-point latch having a knob with a T-handle, and a cylinder lock.

j. Keys: two provided with each lock, with all locks keyed alike.

k. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.15.2 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per JIS C 8480 for connecting grounding conductors; bond to steel cabinet. [In addition to equipment grounding bus, provide second "isolated" ground bus, where indicated.]

[2.15.2.1 Panelboard Neutrals for Non-Linear Loads]

Provide in accordance with the following:.
2.15.3 Circuit Breakers

JIS C 8201-2-1,[ thermal magnetic-type][ solid state-type] having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided.[ Where indicated on the drawings, provide circuit breakers with shunt trip devices.] Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.15.3.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.15.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter or Type RCBO

JIS C 8222. [Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of JIS C 8222 for Class A ground-fault circuit interrupter.][Provide Residual Current Device (RCBO) circuit breaker with a leakage current detection of 15 milliamperes or 30 milliamperes to provide ground fault protection.]

2.15.3.3 Circuit Breakers for HVAC Equipment

Provide circuit breakers for HVAC equipment having motors (group or individual) marked for use with HACR type and UL listed as HACR type.

2.15.3.4 Arc-Fault Circuit Interrupters

JIS C 8201-2-1. Molded case circuit breakers: rated as indicated.[ Two pole arc-fault circuit-interrupters: rated 120/240 volts. The provision of (two) one pole circuit breakers for shared neutral circuits in lieu of (one) two pole circuit breaker is unacceptable.] Provide with "push-to-test" button.
2.15.4 Fusible Switches for Panelboards

JIS C 8201-3, hinged door-type. Provide switches serving as motor disconnect means rated for kilowatt.

2.15.5 400 Hz Panelboard and Breakers

Provide panelboards and breakers for use on 400 Hz systems rated and labeled "400 Hz."

2.16 RESIDENTIAL LOAD CENTERS

Provide residential load centers (RLCs) in accordance with the following:

a. JIS C 8480 and JIS C 8480, JIS C 0920.

b. RLCs for use as service disconnecting means: additionally conform to manufacturer's recommendations.

c. Circuit breaker equipped.

d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. Where "space only" is indicated, make provisions for future installation of breakers sized as indicated.

f. Provide load centers with keyed locks.

g. Provide printed directories.

2.16.1 RLC Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated groundable neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per JIS C 8480 for connecting grounding conductors; bond to steel cabinet.

2.16.2 Circuit Breakers

JIS C 8201-2-1, thermal magnetic-type with interrupting capacity[as indicated][of 10,000 minimum amperes rms symmetrical]. Breaker terminals: UL listed as suitable for the type of conductor provided.

2.16.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Provide a breaker design such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any two adjacent breaker poles are connected to alternate phases in sequence.

2.16.2.2 Circuit Breaker With Ground-Fault Circuit Interrupter or Type RCBO

JIS C 8222. [Provide with "push-to-test" button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater per requirements of JIS C 8222 for Class A]
ground-fault circuit interrupter devices.][Provide Residual Current Device (RCBO) circuit breaker with a leakage current detection of 15 milliamperes or 30 milliamperes to provide ground fault protection.]

2.16.2.3 Arc-Fault Circuit-Interrupters

JIS C 8201-2-1. Molded case circuit breakers: rated as indicated. [Two pole arc-fault circuit-interrupters: rated [105/210][120/240] volts. The provision of (two) one pole circuit breakers for shared neutral circuits in lieu of (one) two pole circuit breaker is unacceptable.] Provide with "push-to-test" button.

2.17 LOAD CENTERS FOR HOUSING UNITS

Provide single-phase panelboards for housing units on this project in accordance with the following:

a. Load center type, circuit breaker equipped, conforming to JIS C 8480 and JIS C 8480 or JIS C 0920.

b. Panelboards series short-circuit current rating: 22,000 amperes symmetrical minimum for the main breaker and the branch breakers.

c. Panelboards for use as service disconnecting means: additionally conform to manufacturer's recommendations.

d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings.

f. Where "space only" is indicated, make provisions for future installation of breakers.

g. Provide cover with latching door.

h. Directories: indicate load served by each circuit in panelboard.

i. Directories: indicate source of service to panelboard (e.g., Panel PA served from panel MDP).

j. Type directories and mount behind in holder with transparent protective covering on inside of panel door.

2.17.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide copper or aluminum bus bars, either tin plated or silver plated. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per JIS C 8480 for connecting grounding conductors; bond to steel cabinet.
2.17.2 Circuit Breakers

JIS C 8201-2-1 thermal magnetic type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Half-size and tandem breakers are not acceptable. Provide switch duty rated 15 and 20 ampere breakers. Breakers must not require use of panel trim to secure them to the bus.

2.17.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any two adjacent breaker poles are connected to Phases A and B respectively.

2.17.2.2 Arc-Fault Circuit-Interrupters

JIS C 8201-2-1. Molded case circuit breakers: rated as indicated. Two pole arc-fault circuit-interrupters: rated [1050/210][120/240] volts. The provision of (two) one pole circuit breakers for shared neutral circuits in lieu of (one) two pole circuit breaker is unacceptable. Provide with "push-to-test" button.

2.18 ENCLOSED CIRCUIT BREAKERS

JIS C 8201-2-1. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

[2.19 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)]

Motor short-circuit protectors, also called motor circuit protectors (MCPs): JIS C 8201-5-1 and JIS C 8201-2-1, and provided as shown. Provide MSCPs that consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. Rate MSCPs in accordance with MLIT ESS.

2.20 TRANSFORMERS

Provide transformers in accordance with the following:

a. JEC 2200 and JIS C 61558-1, general purpose, dry-type, self-cooled,[ ventilated][ unventilated][ sealed].

b. Provide transformers in indoor rated or weatherproof IP rated enclosure.

c. Transformer insulation system:

(1) 220 degrees C insulation system for transformers 15 kVA and greater, with temperature rise not exceeding[ 150][ 115][ 80] degrees C under full-rated load in maximum ambient of 40 degrees C.

(2) 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding[ 150][ 115][ 80] degrees C
under full-rated load in maximum ambient of 40 degrees C.

d. Transformer of 150 degrees C temperature rise: capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

e. Transformer of 115 degrees C temperature rise: capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

f. Transformer of 80 degrees C temperature rise: capable of carrying continuously 130 percent of nameplate kVA without exceeding insulation rating.

g. Transformers: quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.20.1 Specified Transformer Efficiency

Transformers, indicated and specified with: [420][440V][480V] primary, 80 degrees C or 115 degrees C temperature rise, kVA ratings of 37.5 to 100 for single phase or 30 to 500 for three phase, energy efficient type. Minimum efficiency, based on factory test results.

2.20.2 Transformers With Non-Linear Loads

Provide transformers for non-linear loads in accordance JIS C 61000-4-7.

2.21 MOTORS

Provide motors in accordance with the following:

a. JIS C 4212[ except provide fire pump motors as specified in Section 21 30 00] FIRE PUMPS.

b. Provide the size in terms of kW, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.

c. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.

d. Rate motors for operation on [200-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on [400][440] volt, 3 phase circuits with a terminal voltage rating of [400][440] volts.][208-volt, 3-phase circuits with a terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits with a terminal voltage rating of 460 volts.]

e. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

f. Unless otherwise indicated, use continuous duty type motors if rated 745 Watts and above.

h. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.
2.21.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: high efficiency types corresponding to the applications listed in JIS C 4212. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.21.2 Premium Efficiency Polyphase Motors

Select polyphase motors based on high efficiency characteristics relative to typical characteristics and applications as listed in JIS C 4212. In addition, continuous rated, polyphase squirrel-cage medium induction motors must meet the requirements for premium efficiency electric motors in accordance with JIS C 4212, including the full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.21.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp (746 watts) and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.21.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment[, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment] as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.22 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

a. JIS C 8201-5-1, JIS C 8201-4-1 and JIS C 8201-4-2,[ except fire pump controllers as specified in Section 21 30 00 FIRE PUMPS].

b. Provide controllers with thermal overload protection in each phase, and one spare normally open auxiliary contact, and one spare normally closed auxiliary contact.

c. Provide controllers for motors rated 1-hp (746 kilowatt) and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage.
d. Provide protection for motors from immediate restart by a time adjustable restart relay.

e. When used with pressure, float, or similar automatic-type or maintained-contact switch, provide a hand/off/automatic selector switch with the controller.

f. Connections to selector switch: wired such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.

g. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices: connected in motor control circuit in "hand" and "automatic" positions.

h. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device: made in accordance with indicated or manufacturer's approved wiring diagram.

[ i. Provide selector switch with the means for locking in any position.

] j. Provide a disconnecting means, capable of being locked in the open position, for the motor that is located in sight from the motor location and the driven machinery location. As an alternative, provide a motor controller disconnect, capable of being locked in the open position, to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.

l. Overload protective devices: provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.

m. Cover of combination motor controller and manual switch or circuit breaker: interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.


][o. Provide controllers in hazardous locations with classifications as indicated.

]2.22.1 Control Wiring

Provide control wiring in accordance with the following:

a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type CCE/F meeting JIS C 3401, or Type CEE/F meeting JIS C 3401, and passing the flame tests included in those standards.

b. Current transformer secondary leads: not smaller than 5.5 sqmm

c. Control wire minimum size: 1.6mm

d. Power wiring for [400][440][480]-volt circuits and below: the same type as control wiring with 2.0mm minimum size.
2.22.2 Control Circuit Terminal Blocks

Provide control circuit terminal blocks in accordance with the following:

a. JIS C 8201-7-1.

b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.

c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.

d. Terminals: not less than 5.5 sqmm in size with sufficient length and space for connecting at least two indented terminals for 5.5 sqmm conductors to each terminal.

e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four (4) spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.

f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.

g. Submit data showing that any proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.22.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity: provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. Provide terminals of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, provide screws with hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating. Provide each connected terminal with the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.22.3 Control Circuits

[Control circuits: maximum voltage of [105][120] volts derived from control transformer in same enclosure. Transformers: conform to JIS C 6436, as applicable. Transformers, other than transformers in bridge circuits: provide primaries wound for voltage available and secondaries wound for]
Correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side.[Provide fuses in each ungrounded primary feeder]. Provide one fused secondary lead with the other lead grounded.[For designated systems, as indicated, provide backup power supply, including transformers connected to[emergency power source][_____]. Provide for automatic switchover and alarm upon failure of primary control circuit.]

[Control circuits: maximum voltage of [105][120] volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. Provide one fused secondary lead with the other lead grounded.[For designated systems, as indicated, provide backup power supply, including connection to[emergency power source][_____]. Provide for automatic switchover and alarm upon failure of primary control circuit.]

2.22.4 Enclosures for Motor Controllers

JIS C 8462-1.

2.22.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers: include compelling relays and multiple-button, station-type with pilot lights for each speed.

2.22.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations: heavy duty, oil-tight design.

2.22.7 Pilot and Indicating Lights

[Provide LED cluster lamps.][Provide transformer, resistor, or diode type.]

2.22.8 Reduced-Voltage Controllers

Provide for polyphase motors [_____] kilowatt and larger. Reduced-voltage starters: single-step, closed transition[autotransformer,][reactor,][primary resistor-type,][solid state-type,] or as indicated, with an adjustable time interval between application of reduced and full voltages to motors.[Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of[motor-generator sets,][centrifugally operated equipment,][or][reciprocating compressors provided with automatic unloaders].]

2.23 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

[Single][Double][Three] pole designed for[flush][surface] mounting with overload protection[and pilot lights].

2.23.1 Pilot Lights

[Provide yoke-mounted, seven element LED cluster light module. Color:[green][red][amber][in accordance with JIS C 8201-4-1 and JIS C 8201-4-2].][Provide yoke-mounted, candelabra-base sockets rated 125 volts and
fitted with glass or plastic jewels. Provide clear, 6 watt lamp in each pilot switch. Jewels for use with switches controlling motors: green; jewels for other purposes: [white][red][amber].

2.24 MOTOR CONTROL CENTERS

Provide motor control centers in accordance with the following:

a. JIS C 8201-4-1, JIS C 8201-4-1 and JIS C 8201-4-2.

b. Wiring: in [indoor][weatherproof][] IP rated enclosure per JIS C 0920.

c. Provide control centers suitable for operation on [_____]-volt, [_____]-phase, [_____]-wire, [_____] Hz system with minimum short-circuit withstand and interrupting rating of [100,000][65,000][42,000][25,000][_____] amperes rms symmetrical.

d. Incoming power feeder: [bus duct][cable] entering at the [top][bottom] of enclosure and terminating on [terminal lugs][main protective device].

e. Main protective device: [molded case circuit breaker][low-voltage power circuit breaker][fusible switch] rated at [_____] amperes rms symmetrical interrupting capacity.

f. Arrange busing so that control center can be expanded from both ends.

g. Interconnecting wires: copper.

h. Terminal blocks: plug-in-type so that controllers may be removed without disconnecting individual control wiring.

2.24.1 Bus Systems

Provide the following bus systems. Power bus: be braced to withstand fault current of [100,000][65,000][42,000][25,000][_____] amperes rms symmetrical. Wiring troughs: isolated from horizontal and vertical bus bars.

2.24.1.1 Horizontal and Main Buses

Horizontal bus: continuous current rating of [600][800][1000][1200][_____] amperes. Main bus: [aluminum, tin-plated][copper, silver-plated] enclosed in isolated compartment at top of each vertical section. Main bus: isolated from wire troughs, starters, and other areas.

2.24.1.2 Vertical Bus

Vertical bus: continuous current rating of [300][450][600][_____] amperes, and [aluminum, tin-plated][copper, tin-plated][copper, silver-plated]. Vertical bus: enclosed in flame-retardant, polyester glass "sandwich."

2.24.1.3 Ground Bus

Copper ground bus: provided full width of motor control center and equipped with necessary lugs.
2.24.1.4 Neutral Bus

Insulated neutral bus: provided continuous through the motor control center; neutral full rated. Provide lugs of appropriate capacity, as required.

2.24.2 Combination Motor Controllers

JIS C 8201-5-1 and other requirements in paragraph, MOTOR CONTROLLERS. Provide in controller a[ molded case circuit breaker][ fusible switch with clips for [_____]-type fuses for branch circuit protection].[ Minimum short circuit withstand rating of combination motor controller: [_____] rms symmetrical amperes.][ Circuit breakers for combination controllers: [ thermal magnetic][ magnetic only].]

2.24.3 Space Heaters

Provide space heaters where indicated on the drawings, controlled using an adjustable 10 to 35 degrees C thermostat, magnetic contactor, and a molded-case circuit breaker[ and a [480][400]-[120][100] volt single-phase transformer]. Provide space heaters equipped with 250-watt, [210][240] volt strip elements operated at [105][120] volts and [ supplied from the motor control center bus][ wired to terminal blocks for connection to [105][120]-volt single-phase power sources located external to the control centers]. Contactors: open type, electrically-held, rated 30 amperes, 2-pole, with 120-volt ac coils.

2.25 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with MLIT ESS. Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.26 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires[ wireways],[ cable trays,] and other accessories for telecommunications outlets and pathway in accordance with the drawings and as specified herein.[ Additional telecommunications requirements are specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING SYSTEM.]

2.27 COMMUNITY ANTENNA TELEVISION (CATV) SYSTEM

[Additional CATV requirements are specified in[ Section 27 54 00.00 20, COMMUNITY ANTENNA TELEVISION (CATV) SYSTEMS.][ Section 27 05 14.00 10, CABLE TELEVISION PREMISES DISTRIBUTION SYSTEM.]]

2.27.1 CATV Outlets

Provide flush mounted, 75-ohm, F-type connector outlet rated from 5 to 1000 MHz in standard electrical outlet boxes[ with isolation barrier] with mounting frame.

2.27.2 CATV Faceplates

Provide modular faceplates for mounting of CATV Outlets.[ Faceplate: include designation labels and label covers for circuit identification.]
Faceplate color: match outlet and switch coverplates.

][2.27.3 Backboards

[Provide void-free, fire rated interior grade plywood, 19 mm thick,[ 1200 by 2400 mm][ as indicated]. Do not cover the fire stamp on the backboard.][ Coordinate CATV backboard requirements with telecommunications backboard requirements as specified in Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLING.]

]2.28 GROUNDING AND BONDING EQUIPMENT

2.28.1 Ground Rods

JIS C 60364-5-54. Ground rods: [ copper-clad steel][ solid copper][ stainless steel], with minimum diameter of 14mm and minimum length 1500mm. Sectional ground rods are permitted.

2.28.2 Ground Bus

Copper ground bus: provided in the electrical equipment rooms as indicated.

2.28.3 Telecommunications [and CATV]Grounding Busbar

Provide corrosion-resistant grounding busbar suitable for [ indoor][ outdoor] installation in accordance with JIS C 60364-5-54. Busbars: plated for reduced contact resistance. If not plated, clean the busbar prior to fastening the conductors to the busbar and apply an anti-oxidant to the contact area to control corrosion and reduce contact resistance. Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance facility[ and a (TGB) in all other telecommunications rooms and equipment rooms]. The telecommunications main grounding busbar (TMGB)[ and the telecommunications grounding busbar (TGB)]: sized in accordance with the immediate application requirements and with consideration of future growth. Provide telecommunications grounding busbars with the following:

a. Predrilled copper busbar provided with holes for use with standard sized lugs,

b. Minimum dimensions of 6 mm thick by 100 mm wide for the TMGB[ and 50 mm wide for TGBs] with length as indicated;

c. Listed by a nationally recognized testing laboratory.

2.29 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by JIS: specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations: as indicated. Equipment in hazardous locations: comply with JIS C 60079-0 and JIS C 60079-14 for electrical equipment and industrial controls and JIS C 60079-0 and JIS C 60079-14 for motors.

2.30 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment a nameplate bearing the manufacturer's
name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.31 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

a. JIS K 6911.

b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.

c. Each nameplate inscription: identify the function and, when applicable, the position.

d. Nameplates: melamine plastic, 3 mm thick, white with [black] [_____] center core.

[ e. Provide red laminated plastic label with white center core where indicated.


g. Minimum size of nameplates: 25 by 65 mm.

h. Lettering size and style: a minimum of 6.35 mm high normal block style.

2.32 WARNING SIGNS

Provide field installed signs to warn qualified persons of potential electric arc flash hazards when warning signs are not provided by the manufacturer in accordance with NFPA 70E and JIS Z 9101 for switchboards, panelboards, industrial control panels, and motor control centers. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.33 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING.

2.34 WIREWAYS

Material: steel[ epoxy painted][ galvanized] 16 gauge for heights and depths up to 150 by 150 mm, and 14 gauge for heights and depths up to 305 by 305 mm. Provide in length[ indicated][ required for the application] with[ hinged-][ screw-] cover enclosure per [indoor][weatherproof][hazardous] IP rated enclosure per JIS C 8462-1.

[2.35 METERING

JIS C 1210. Provide a self-contained, socket-mounted, electronic programmable outdoor watthour meter. Meter: either programmed at the factory or programmed in the field. Turn field programming device over to the Contracting Officer at completion of project. Coordinate meter to system requirements. [Metering shall be compliant with the current Advanced Meter Reading System (AMRS) specification.]

b. Class: 200; Form: [2S][______], accuracy: plus or minus 1.0 percent; Finish: Class II.

c. Cover: Polycarbonate and lockable to prevent tampering and unauthorized removal.

d. Kilowatt-hour Register: five digit electronic programmable type.

e. Demand Register:
   (1) Provide solid state.
   (2) Meter reading multiplier: Indicate multiplier on the meter face.
   (3) Demand interval length: programmed for [15][30][60] minutes with rolling demand up to six subintervals per interval.


][2.36 METER BASE ONLY

JIS C 1210. Provide [weatherproof][] IP rated, box-mounted socket, ringless, having jaws compatible with requirements of a class: 200 and Form: [2S][______] self contained watthour meter. Provide gray plastic closing cover and bypass links. Provide manufacturers standard enclosure color unless otherwise indicated.

]2.37 SURGE PROTECTIVE DEVICES

Provide surge protective devices (SPD) which comply with JIS C 5381-11 and JIS C 5381-12 at the service entrance, load centers, MCC and [______]. Provide surge protectors in an [indoor][weatherproof] IP rated enclosure per JIS C 8462-1. Use Type 1 or Type 2 SPD and connect on the load side of a dedicated circuit breaker.

[ Provide SPDs per JIS Z 9290-1 for the lightning protection system.

]2.38 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

a. JIS C 0920 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.
c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: Light Gray,[ and equipment located outdoors: [ Light Gray][ Dark Gray]].

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.39 SOURCE QUALITY CONTROL

2.39.1 Transformer Factory Tests

Submittal: include routine JEC 2200 and JIS C 61558-1 transformer test results on each transformer and also provide the results of Japanese standard "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

[2.40 COORDINATED POWER SYSTEM PROTECTION]

Prepare analyses as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

]PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of MLIT ESS, IEEE C2, JIS C 0365 and to requirements specified herein.

[3.1.1 Underground Service

Underground service conductors and associated conduit: continuous from service entrance equipment to outdoor power system connection.

][3.1.2 Overhead Service

Overhead service conductors into buildings: terminate at service entrance fittings or weatherhead outside building. Overhead service conductors and support bracket for overhead conductors are included in[ Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.]

][3.1.3 Hazardous Locations

Perform work in hazardous locations, as defined by applicable codes and standards, for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required. Provide conduit with tapered threads.
3.1.4 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled and identified as such.

3.1.4.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 6.35 mm in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted.

3.1.5 Wiring Methods

Provide insulated conductors installed in rigid steel conduit or type G, IMC or type C, rigid nonmetallic conduit or Unplasticized Polyvinyl Chloride, or EMT or Type E, except where specifically indicated or specified otherwise or required to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. [Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters.] Minimum conduit size: 16 mm in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 150 mm. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with Section 07 84 00, FIRESTOPPING.

3.1.5.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 890-N force tensile strength. Leave minimum 915 mm of slack at each end of pull wire.

3.1.5.2 Metal Clad Cable

Install in accordance with manufacturer's requirements, Type MC cable.

3.1.5.3 Armored Cable

Install in accordance with manufacturer's requirements, Type AC cable.

3.1.5.4 Flat Conductor Cable

Install in accordance with manufacturer's requirements, Type FCC cable.

3.1.6 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 150 mm away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible.
after completion of project. [Run conduits in crawl space] [under floor slab] as if exposed.

3.1.6.1 Restrictions Applicable to EMT or Type E

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT or Type E conduit.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.6.2 Restrictions Applicable to Nonmetallic Conduit or Type VE, HIVE, VP, HIVP

a. PVC Schedule 40 and PVC Schedule 80 or Type VE, HIVE, VP, HIVP

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

(6) Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.6.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.6.4 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC or type C, LL or LT; PVC, Type EPC-40 or Type VE, HIVE, VP, HIVP. Convert nonmetallic conduit, other than PVC Schedule 40 or 80 or Type VE, HIVE, VP, HIVP, to plastic-coated rigid, or IMC, steel conduit before rising through floor.
slab. Plastic coating: extend minimum 150 mm above floor.

3.1.6.5 Conduit Interior to Buildings for 400 Hz Circuits

Aluminum or nonmetallic. Where 400-Hz circuit runs underground or through concrete, provide PVC Schedule[ 40][ 80] or Type VE, HIVE, VP, HIVP conduit.

3.1.6.6 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or Type G only.

3.1.6.7 Conduit Installed Under Floor Slabs

Conduit run under floor slab: located a minimum of [305] mm below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.6.8 Conduit Through Floor Slabs

Where conduits rise through floor slabs, do not allow curved portion of bends to be visible above finished slab.

3.1.6.9 Conduit Installed in Concrete Floor Slabs

[Rigid steel or Type G; steel IMC or Type C; fiberglass, or PVC, Type EPC-40.][PVC, Type EPC-40, unless indicated otherwise.] Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab.[ Do not stack conduits.][ Do not stack conduits more than two diameters high with minimum vertical separation of _____ mm.] Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends must not be visible above finish slab. Increase slab thickness as necessary to provide minimum 25 mm cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings must allow horizontal and vertical movement of raceway. Conduit larger than 27 mm trade size: installed parallel with or at right angles to main reinforcement; when at right angles to reinforcement, install conduit close to one of supports of slab.[ Where nonmetallic conduit is used, convert raceway to plastic coated rigid steel or Type G or plastic coated steel IMC or Type C; LL or LT before rising above floor, unless specifically indicated.]

3.1.6.10 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 150 mm above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.6.11 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide
vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 40 mm in reinforced concrete beams or to depth of more than 20 mm in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations.[ Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 3050 mm maximum intervals.] Where conduit crosses building expansion joints, provide suitable[ watertight] expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 63 mm inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.6.12 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.6.13 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required.

3.1.6.14 Flexible Connections

Provide flexible steel conduit between 915 and 1830 mm in length for recessed and semirecessed lighting fixtures[; for equipment subject to vibration, noise transmission, or movement; and for motors]. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 16 mm diameter. Provide liquidtight flexible[ nonmetallic] conduit in wet and damp locations[ and in fire pump rooms] for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.6.15 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with JIS X 5150.

a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with JIS X 5150. Size conduits[, wireways][, and cable trays] in accordance with JIS X 5150[ and][ as indicated].
b. Backbone Pathway: Telecommunication pathways from the telecommunications entrance facility to telecommunications rooms, and, telecommunications equipment rooms (backbone cabling): installed in accordance with JIS X 5150. Size conduits[, wireways][, and cable trays] for telecommunications risers in accordance with JIS X 5150[ and][ as indicated].

3.1.6.16 Community Antenna Television (CATV) System Conduits

Install a system of CATV wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires[ wireways,][ cable trays,] and other accessories for CATV outlets and pathway in accordance with JIS X 5150. [Provide distribution system with star topology with empty conduit and pullwire from each outlet box to the telecommunications room and empty conduit and pullwire from each telecommunications room to the headend equipment location][Provide distribution system with star topology with empty conduit and pullwire from each outlet to the headend equipment location].

3.1.7 Busway Installation

Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 1525 mm maximum intervals, and brace to prevent lateral movement. Provide fixed type hinges on risers; spring-type are unacceptable. Provide flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor. Seal gaps with fire-rated foam and caulk. Provide expansion joints, but only where bus duct crosses building expansion joints. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.8 Cable Tray Installation

[ Install and ground in accordance with manufacturer's instructions.[ In addition, install and ground telecommunications cable tray in accordance with JIS X 5150, and JIS C 60364-5-54]. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support[ in accordance with manufacturer recommendations but at not more than [1830] [_____] mm intervals][ as indicated].[ Coat contact surfaces of aluminum connections with an antioxidant compound prior to assembly.] Adjacent cable tray sections: bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide 38 sqmm bare copper wire throughout cable tray system, and bond to each section, except use 60 sqmm aluminum wire if cable tray is aluminum. Terminate cable trays 255 mm from both sides of smoke and fire partitions. Install conductors run through smoke and fire partitions in 103 mm rigid steel conduits with grounding bushings, extending 305 mm beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Firestop penetrations in accordance with Section 07 84 00, FIRESTOPPING. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

][Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support[ as indicated][ at maximum [1830] [_____] mm] intervals.[ In addition, install and ground telecommunications cable tray in accordance with JIS X 5150, and JIS C 60364-5-54][ Coat contact
surfaces of aluminum connections with an antioxidant compound prior to assembly.] Ensure edges, fittings, and hardware are finished free from burrs and sharp edges. Provide 38 sqmm bare copper wire throughout cable tray system, and bond to each section. Use 60 sqmm aluminum wire if cable tray is aluminum. Install conductors that run through smoke and fire partitions in 103 mm rigid steel conduits with grounding bushing, extending 305 mm beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.9 Telecommunications Cable Support Installation

Install open top and closed ring cable supports on 1.2 m to 1.5 m centers to adequately support and distribute the cable’s weight. Use these types of supports to support a maximum of 50 6.4 mm diameter cables. Install suspended cables with at least 75 mm of clear vertical space above the ceiling tiles and support channels (T-bars). Open top and closed ring cable supports: suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.

3.1.10 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces,[ when surface mounted on interior walls exposed up to 2135 mm above floors and walkways,][ or when installed in hazardous areas] and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic[ sheathed cable] conduit system. Provide each box with volume required for number of conductors enclosed in box. Boxes for mounting lighting fixtures: minimum 100 mm square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls: square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; provide readily removable fixtures for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel.[ Threaded studs driven in by powder charge and provided with lockwashers and nuts[ or nail-type nylon anchors] may be used in lieu of wood screws, expansion shields, or machine screws.] In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 610 mm from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.
3.1.10.1 Boxes

Boxes for use with raceway systems: minimum 40 mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 100 mm square, except that 100 by 50 mm boxes may be used where only one raceway enters outlet. Telecommunications outlets: a minimum of [100 mm square by 54 mm deep][120 mm square by 54 mm deep], except for [wall mounted telephones] [and] [outlet boxes for handicap telephone stations]. Mount outlet boxes flush in finished walls.

3.1.10.2 Pull Boxes

Construct of at least minimum size required [of code-gauge aluminum or galvanized sheet steel], [and] [compatible with nonmetallic raceway systems], except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.10.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.11 Mounting Heights

Mount panelboards, [enclosed] circuit breakers, [motor controller] and disconnecting switches so height of operating handle at its highest position is maximum 1980 mm above floor. Mount lighting switches [and handicapped telecommunications stations] [1220 mm above finished floor]. Mount receptacles [and telecommunications outlets] 460 mm above finished floor[, unless otherwise indicated].[ Wall-mounted telecommunications outlets: mounted at height [1525 mm above finished floor][ indicated].] [Mount other devices as indicated.][ Measure mounting heights of wiring devices and outlets [in non-hazardous areas] to center of device or outlet.][ Measure mounting heights of receptacle outlet boxes in the[ hazardous area][_____] to the bottom of the outlet box.]

3.1.12 Nonmetallic Sheathed Cable Installation

Where possible, install cables concealed behind ceiling or wall finish. Thread cables through holes bored on approximate centerline of wood members; notching of end surfaces is not permitted. Provide sleeves through concrete or masonry for threading cables. Install exposed cables parallel to or at right angles to walls or structural members. Protect exposed nonmetallic sheathed cables less than 1220 mm above floors from mechanical injury by installation in conduit or tubing. When cable is used in metal stud construction, insert plastic stud grommets in studs at each point through which cable passes, prior to installation of cable.

3.1.13 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes: not less than those indicated for the conduit installation. Fasten cables within 305 mm of each turn or offset and at 830 mm maximum intervals. Make cable terminations in accordance with cable manufacturer's recommendations.
Terminate single-conductor cables of a circuit, having capacities of more than 50 amperes, in a single box or cabinet opening. Color code individual conductors in all outlets and cabinets.

3.1.14 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors 14 sqmm and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors 22 sqmm and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with [Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS.][ Section [_____, [_____,][ Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC][ manufacturer's recommendations].[ Provide telecommunications system identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.]

3.1.14.1 Marking Strips

Provide marking strips in accordance with the following:

a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

b. Use permanent ink for the wire numbers

c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.

d. Size marking strips to accommodate the two sets of wire numbers.

e. Assign a device designation in accordance with JIS C 8201-4-1 and JIS C 8201-4-2 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.

f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.

g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.15 Splices

Make splices in accessible locations. Make splices in conductors 5.5 sqmm and smaller diameter with insulated, pressure-type connector. Make splices in conductors 8 sqmm and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.16 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces
without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 0.58 mm. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.17 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.18 Grounding and Bonding

[Provide in accordance with JIS Z 9290-1]. Ground exposed, non-current-carrying metallic parts of electrical equipment, access flooring support system, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, grounding conductor of nonmetallic sheathed cables, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode.[ Make ground connection to driven ground rods on exterior of building.][ Intercconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Make interconnection to the gas line on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with JIS C 60364-5-54. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.18.1 Ground Rods

Provide cone pointed ground rods. Measure the resistance to ground using the fall-of-potential method described in JIS C 60364-6. Do not exceed 25 ohms under normally dry conditions for the maximum resistance of a driven ground. If this resistance cannot be obtained with a single rod, additional rods, spaced on center, not less than twice the distance of the length of the rod, or if sectional type rods are used, additional sections may be coupled and driven with the first rod.[ In high-ground-resistance, UL listed chemically charged ground rods may be used.] If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.18.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

da. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or...
which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.18.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100 mm above the floor. Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, provide a minimum of 4, one at each corner, ground buses connected to the building grounding system. Use bolted connections in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.18.4 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.18.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

a. Telecommunications Grounding Busbars: Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance facility. Install the TMGB as close to the electrical service entrance grounding connection as practicable. Provide a telecommunications grounding busbar (TGB) in all other telecommunications rooms and telecommunications equipment rooms. Install the TGB as close to the telecommunications room panelboard as practicable, when equipped. Where a panelboard for telecommunications equipment is not installed in the telecommunications room, locate the TGB near the backbone cabling and associated terminations. In addition, locate the TGB to provide for the shortest and straightest routing of the grounding conductors. Where a panelboard for telecommunications equipment is located within the same room or space as a TGB, bond that panelboard’s alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure to the TGB. Install telecommunications grounding busbars to maintain clearances as required and insulated from its support. A minimum of 50 mm separation from the wall is recommended to allow access to the rear of the busbar and adjust the mounting height to accommodate overhead or underfloor cable routing.

b. Telecommunications Bonding Conductors: Provide main telecommunications service equipment ground consisting of separate bonding conductor for telecommunications, between the TMGB and readily accessible grounding connection of the electrical service. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary
to place grounding and bonding conductors in ferrous metallic conduit that exceeds 1 m in length, bond the conductors to each end of the conduit using a grounding bushing or a 14 sqmm conductor, minimum. Provide a telecommunications bonding backbone (TBB) that originates at the TMGB extends throughout the building using the telecommunications backbone pathways, and connects to the TGBs in all telecommunications rooms and equipment rooms. Install the TBB conductors such that they are protected from physical and mechanical damage. The TBB conductors should be installed without splices and routed in the shortest possible straight-line path. Make the bonding conductor between a TBB and a TGB continuous. Where splices are necessary, the number of splices should be a minimum. Make the splices accessible and located in telecommunications spaces. Connect joined segments of a TBB using exothermic welding, irreversible compression-type connectors, or equivalent. Install all joints to be adequately supported and protected from damage. Whenever two or more TBBs are used within a multistory building, bond the TBBs together with a grounding equalizer (GE) at the top floor and at a minimum of every third floor in between. Do not connect the TBB and GE to the pathway ground, except at the TMGB or the TGB.

c. Telecommunications Grounding Connections: Telecommunications grounding connections to the TMGB[ or TGB]: utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections. Bond all metallic pathways, cabinets, and racks for telecommunications cabling and interconnecting hardware located within the same room or space as the TMGB[ or TGB] to the TMGB[ or TGB respectively]. In a metal frame (structural steel) building, where the steel framework is readily accessible within the room; bond each TMGB[ and TGB] to the vertical steel metal frame using a minimum 14 sqmm conductor. Where the metal frame is external to the room and readily accessible, bond the metal frame to the TGB or TMGB with a minimum 14 sqmm conductor. When practicable because of shorter distances and, where horizontal steel members are permanently electrically bonded to vertical column members, the TGB may be bonded to these horizontal members in lieu of the vertical column members. All connectors used for bonding to the metal frame of a building must be listed for the intended purpose.

3.1.19 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.1.20 Elevator

Provide circuit to line terminals of elevator controller, and disconnect switch on line side of controller, outlet for control power, outlet receptacle and work light at midheight of elevator shaft, and work light and outlet receptacle in elevator pit.

3.1.21 Government-Furnished Equipment

Contractor[ rough-in for Government-furnished equipment][ make connections to Government-furnished equipment] to make equipment operate as intended,
including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.22 Repair of Existing Work

Perform repair of existing work[, demolition, and modification of existing electrical distribution systems] as follows:

3.1.22.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.22.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.22.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment includes equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings,[ back to equipment's power source] as indicated.

3.1.22.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original condition.

3.1.23 Watthour Meters

JIS C 1210.

3.1.24 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible. Maximum allowed lead length is 900 mm.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.
3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. [Painting: as specified in Section 09 90 00 PAINTS AND COATINGS.][Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.]

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer[ 5][_____] working days notice prior to[ each][_____] test[s].

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring 14 sqmm and larger diameter using instrument which applies voltage of 1,000 volts DC for 600 volt rated wiring and 500 volts DC for 300 volt rated wiring to provide direct reading of resistance. All existing wiring to be reused shall also be tested.

3.5.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in Denki Hoan Kyokai and MLIT DSKKS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.5.4 Ground-Fault Receptacle Test

[Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.][Test RCBO circuit breakers in accordance with JIS C 8222, Annex G.]

3.5.5 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Contracting Officer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

[3.5.6 Watthour Meter

a. Visual and mechanical inspection]
(1) Examine for broken parts, shipping damage, and tightness of connections.

(2) Verify that meter type, scales, and connections are in accordance with approved shop drawings.

b. Electrical tests

(1) Determine accuracy of meter.

(2) Calibrate watthour meters to one-half percent.

(3) Verify that correct multiplier has been placed on face of meter, where applicable.

-- End of Section --
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SECTION 26 23 00

LOW-VOLTAGE SWITCHGEAR

05/15

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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS) or Japan Electrical Safety Inspection Associations for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2                                   (2017; Errata 1-2 2017; INT 1 2017)
           National Electrical Safety Code

JAPAN ELECTRICAL SAFETY INSPECTION ASSOCIATIONS

Denki Hoan Kyoukai                  Japan Standard for Acceptance Testing and Inspections

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS C 1210                        (1979) General Rules for Electricity Meters


JIS C 5381-11                   (2014) Low-voltage surge protective devices -- Part 11: Surge protective devices connected to low-voltage power systems -- Requirements and test methods


1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.
1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor QC approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29, SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switchgear Drawings; G[, [_____]]

SD-03 Product Data

Switchgear; G[, [_____]]

SD-06 Test Reports

Acceptance Checks and Tests;

SD-10 Operation and Maintenance Data

Switchgear Operation and Maintenance, Data Package 5;

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals;

Equipment Test Schedule;

[ Request for Settings;

][ Required Settings;

] Service Entrance Available Fault Current Label;

1.5 QUALITY ASSURANCE

1.5.1 Product Data

Include manufacturer's information on each submittal for each component, device and accessory provided with the switchgear including:

a. Circuit breaker type, interrupting rating, and trip devices, including available settings.

b. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device.
1.5.2 Switchgear Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

a. One-line diagram including breakers[, fuses][, current transformers, and meters].

b. Outline drawings including front elevation, section views, footprint, and overall dimensions.

c. Bus configuration including dimensions and amperage ratings of bus bars.

d. Markings and NEMA nameplate data[, including fuse information (manufacturer's name, catalog number, and ratings)].

e. Circuit breaker type, interrupting rating, and trip devices, including available settings.

f. Wiring diagrams and elementary diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device. Use this information (designer of record) to provide breaker settings that ensures protection and coordination are achieved. [For Navy installations, provide electronic format curves using SKM's Power Tools for Windows device library electronic format or EasyPower device library format depending on installation modeling software requirements.]

h. Provisions for future expansion by adding switchgear sections.

1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:
a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Switchgear Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Assemble and securely bind manuals in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order with a table of contents:

a. Manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA.

b. Catalog data required by the paragraph SD-03, PRODUCT DATA.

c. Drawings required by the paragraph SD-02, SHOP DRAWINGS.

d. Prices for spare parts and supply list.

[e. Information on metering.]

[f. Design test reports.

g. Production test reports.

1.6.3 Spare Parts

Provide spare parts as specified below. Provide spare parts that are of the same material and workmanship, meet the same requirements, and are interchangeable with the corresponding original parts furnished.
a. Quantity 2 - Fuses of each type and size.

b. [_____]

1.7 WARRANTY

Provide equipment items that are supported by service organizations reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchgear and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHGEAR

JIS C 8201-1.

2.2.1 Ratings

Provide equipment with the following ratings:


b. Continuous current rating of the main bus: [_____ amperes][as indicated].

c. Short-circuit current rating: [_____ rms symmetrical amperes][as indicated].

d. UL listed and labeled[ for its intended use][ as service entrance equipment].

2.2.2 Construction

Provide the following:

a. Switchgear: consisting of vertical sections bolted together to form a rigid assembly and [rear][front and rear] aligned[ as indicated].

b. All circuit breakers: [front accessible with rear load connections][as indicated].

c. Compartmentalized switchgear: vertical insulating barriers between the front device section, the main bus section, and the cable compartment[ with full front to rear vertical insulating barriers between adjacent sections].

d. Where indicated, "space for future" or "space" means to include all necessary components and hardware to be fully equipped for racking in a circuit breaker element.
e. Insulating barriers: provided in accordance with JIS K 6912 6.35 mm minimum thickness.

[ f. Moisture resistant coating: applied to all rough-cut edges of barriers.

][g. Switchgear: Arc-resistant, tested in accordance with manufacturer's requirements.

]2.2.2.1 Enclosure

Provide the following:

a. Enclosure: [outdoor][indoor][weatherproof] IP rated [as indicated] per JIS C 8462-1 [fabricated entirely of 12 gauge, type 304 or 304L stainless steel] per JIS G 4304.

b. Enclosure: bolted together with removable bolt-on side and[ hinged] rear covers[, and sloping roof downward toward rear].

[ c. Front[ and rear] doors: provided with[ stainless steel] padlockable vault handles with a three point catch.

][d. Bases, frames and channels of enclosure: corrosion resistant and fabricated of[ type 304 or 304L stainless steel][ or][ galvanized steel]JIS G 4304.

e. Base: includes any part of enclosure that is within 75 mm of concrete pad.

[ f. Galvanized steel: coating per JIS H 8641 and JIS G 3352, and JIS B 1048, as applicable. Galvanize after fabrication where practicable.

][ g. Paint color: light gray over rust inhibitor.

][ h. Paint coating system: comply with[ JIS C 8480 for galvanized steel][ and][ JIS Z 2371 for stainless steel].

][i. Infrared viewing windows: install to allow the use of an infrared camera or thermal imager direct line of site to inspect electrical connections without requiring the opening of panels and doors. These windows are intended to allow thermographers the ability to inspect the electrical equipment without directly exposing themselves to live electrical components and energized devices.

]2.2.2.2 Bus Bars

Provide the following:

a. Bus bars: [copper with silver-plated contact surfaces][ or][ aluminum with tin-plated contact surfaces].

(1) Phase bus bars: [uninsulated][insulated with an epoxy finish coating powder or insulating sleeve providing a minimum breakdown voltage in accordance with JIS C 2110-1].

(2) Neutral bus: rated [100][_____] percent of the main bus continuous current rating[ as indicated].
b. Make bus connections and joints with hardened steel bolts.

c. Main-bus (through bus): rated at the full ampacity of the main throughout the switchgear.

d. Minimum 6.35 mm by 50.8 mm copper ground bus secured to each vertical section along the entire length of the switchgear.

2.2.2.3 Main Section

Provide the main section consisting of [main lugs only] [an individually mounted] [air power circuit breaker] [with current-limiting fuses] [and utility transformer compartment].

2.2.2.4 Distribution Sections

Provide the distribution section[s] consisting of [individually mounted,] [air power circuit breakers] [with current-limiting fuses] [and utility transformer compartments] as indicated.

2.2.2.5 Auxiliary Sections

Provide auxiliary sections consisting of indicated [instruments,] [metering equipment,] [control equipment,] [transformer,] [and] [current transformer compartments] as indicated.

2.2.2.6 Handles

Provide handles for individually mounted devices of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Protective Device

Provide [main and] branch protective devices as indicated.

Provide the following:

a. JIS C 8201-2-1 and JIS C 8201-2-2. [105 Vac] [120 Vac] [electrically] [manually] operated, [unfused] [fused], low-voltage power circuit breaker with a short-circuit current rating of [_____] rms amperes symmetrical [as indicated] at [_____] volts.

b. Breaker frame size: [as indicated] [_____] amperes.

c. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle.

2.2.4 Electronic Trip Units

Equip [main and] [distribution] breakers [as indicated] with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

a. Current sensors ampere rating: [as indicated] [_____] amperes] [the
same as the breaker frame rating].

b. Trip unit ampere rating: [as indicated][_____] amperes].

c. Ground fault protection: [as indicated][zero sequence sensing][residual type sensing].

d. Electronic trip units: provide additional features[as indicated]:

1. [Indicated] Breakers: include long delay pick-up and time settings, and indication of cause of circuit breaker trip.

2. Main breakers: include[short delay pick-up and time settings][and][instantaneous settings][and][ground fault settings][as indicated].

3. Distribution breakers: include[short delay pick-up and time settings][and][instantaneous settings][and][ground fault settings][as indicated].

4. [Main] Breakers: include a digital display for phase and ground current.

5. [Main] Breakers: include a digital display for watts, vars, VA, kWh, kvarh, and kVAh.

6. [Main] Breakers: include a digital display for phase voltage, and percent THD voltage and current.

7. [Main] Breakers: include provisions for communication via a network twisted pair cable for remote monitoring and control. Provide the following communications protocol:[DNP3][Modbus][IEC 61850].

8. For electronic trip units that are rated for or can be adjusted to 1,200 amperes or higher, provide arc energy reduction capability with an energy-reducing maintenance switch with local status indicator.

2.2.5 Metering

2.2.5.1 Digital Meters

[JIS C 5381-11 and JIS C 61000-4-5 for surge withstand. [Metering shall be compliant with the current Advanced Meter Reading System (AMRS) specification.] Provide true rms, plus/minus one percent accuracy, programmable, microprocessor-based meter enclosed in a sealed case with the following features.]

[Provide meter(s) and connect the meter(s) to the existing Advanced Meter Infrastructure Data Acquisition System (AMI DAS). The contractor shall use the existing government laptop computers to configure the meter using existing software loaded on the computer. The contractor will not be allowed to modify any software or add any additional software to the computer. Alternatively, the government will configure the meter(s), which must be compatible with the existing system, using existing software. Contract shall insure that the meter(s) will transmit the specified data to the DAS. Meters shall be compatible with the Base AMI DAS per NAVFAC Far East requirements.]
a. Display capability:

(1) Multi-Function Meter: Display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, KVA, kVAR, FREQ, kVAh, kWh. Detected alarm conditions include over/under current, over/under voltage, over/under KVA, over/under frequency, over/under selected PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. Include a Form C KYZ pulse output relay on the meter.

(2) Power Meter: Display Watts, VARs, and selected KVA/PF. Detected alarm conditions include over/under KVA, over/under PF, over/under VARs, over/under reverse power.

(3) Volt Meter: Provide capability to be selectable between display of the three phases of phase to neutral voltages and simultaneous display of the three phases of the phase to phase voltages. Detected alarm conditions include over/under voltage, over/under voltage imbalance, over percent THD.

(4) Ammeter: Display phase A, B, and C currents. Detected alarm conditions include over/under current, over percent THD.

(5) Digital Watthour Meter: Provide a single selectable display for watts, total kilowatt hours (kWh) and watt demand (Wd). Include a Form C KYZ pulse output relay on the meter.

b. Design meters to accept input from standard 5A secondary instrument transformers and direct voltage monitoring range to 300-600 volts, phase to phase.

c. Provide programming via a front panel display and a communication interface accessible by a computer.

d. Provide password secured programming stored in non-volatile EEPROM memory.


f. Provide meter that calculates and stores average max/min demand values with time and date for all readings based on a user selectable sliding window averaging period.

g. Provide meter with programmable hi/low set limits with two dry contact relays when exceeding alarm conditions.

h. Meter shall have two-way communication with the existing DAS. Provide a communications interface utilizing fiber-optic LC connection.

2.2.5.2 Electronic Watthour Meter

JIS C 1210. Provide a switchgear style electronic programmable watthour meter, semi-flush mounted, as indicated. Meter can be either programmed at
the factory or programmed in the field. Turn field programming device over to the Contracting Officer at completion of project. Coordinate meter to system requirements.

a. Design: Provide meter designed for use on a 3-phase, 4-wire, [210Y/105] [208Y/120][440Y/254][420Y/242][480Y/277] volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

b. Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

c. Class: 20. Accuracy: plus or minus 1.0 percent. Finish: Class II.

d. Kilowatt-hour Register: five digit electronic programmable type.

e. Demand Register:

(1) Provide solid state.

(2) Display actual values and readings of the metered circuit. No multipliers must be required.

(3) Demand interval length: programmed for [15][30][60] minutes with rolling demand up to six subintervals per interval.

f. Meter fusing: Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

g. Provide meter with a communications port, RS485, with Modbus RTU serial or Ethernet, Modbus-TCP communications.

JIS C 1731-1. Provide single ratio transformers, [50][60] hertz, [_____] to 5-ampere ratio, [_____] rating factor, with a metering accuracy class of 0.3 through [_____].

[ Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to voltage sensing meters. Size fuses as recommended by the meter manufacturer.]

][2.2.5.3 Submetering

. Provide submetering for [_____] [in accordance with drawings].

][2.2.6 Transformer

Provide transformer section in switchgear as indicated. Provide the transformer and section that is suitable for the installation. Provide a transformer conforming to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

][2.2.7 Heaters

Provide [105][120]-volt heaters in each switchgear section. Provide heaters of sufficient capacity to control moisture condensation in the section, 250 watts minimum, and controlled by a thermostat[ and humidistat] located in the section. Provide industrial type thermostat, high limit, to maintain sections within the range of 15 to 32 degrees C.[ Provide
humidistat with a range of 30 to 60 percent relative humidity.] Obtain supply voltage for the heaters from a control power transformer within the switchgear. If heater voltage is different than switchgear voltage, provide transformer rated to carry 125 percent of heater full load rating. Provide transformer with a 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and conforming to JIS C 61558-1.[

Energize electric heaters in switchgear assemblies while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.]

2.2.8 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Provide short-circuiting type terminal boards associated with current transformer. Terminate conductors for current transformers with ring-tongue lugs. Provide terminal board identification that is identical in similar units. Provide color coded external wiring that is color coded consistently for similar terminal boards.

2.2.9 Wire Marking

Mark control and metering conductors at each end. Provide factory installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Provide a single letter or number on each sleeve, elliptically shaped to securely grip the wire, and keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Indicate on each wire marker the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 MANUFACTURER'S NAMEPLATE

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

JIS K 6911. Provide laminated plastic nameplates for each switchgear, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Identify on each nameplate inscription the function and, when applicable, the position. Provide nameplates of melamine plastic, 3 mm thick, white with [black][_____] center core.[ Provide red laminated plastic label with white center core where indicated.] Provide matte finish surface. Provide square corners. Accurately align lettering and engrave into the core. Provide nameplates with minimum size of 25 by 65 mm. Provide lettering that is a minimum of 6.35 mm high normal block style.
2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Provide the following as part of test equipment calibration:

a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

b. Accuracy: Traceable to the National Institute of Standards and Technology.

c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.

d. Dated calibration labels: visible on all test equipment.

e. Calibrating standard: higher accuracy than that of the instrument tested.

f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.5.2 Switchgear Design Tests

JIS C 8201-1.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current test.

b. Enclosure tests.

c. Dielectric test.

[2.5.2.2 Additional Design Tests

In addition to normal design tests, perform the following tests on the actual equipment. Furnish reports which include results of design tests performed on the actual equipment.

a. Temperature rise tests.
b. Continuous current.

2.5.3 Switchgear Production Tests

Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

a. [50][60]-hertz dielectric tests.
b. Mechanical operation tests.
c. Electrical operation and control wiring tests.
d. Ground fault sensing equipment test.

2.6 COORDINATED POWER SYSTEM PROTECTION

Provide a power system study as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

2.7 ARC FLASH WARNING LABEL

Provide warning label of potential electrical arc flash hazards for switchgear in accordance with NFPA 70E and JIS Z 9101.

2.8 SERVICE ENTRANCE AVAILABLE FAULT CURRENT LABEL

Provide label on exterior of switchgear used as service equipment listing the maximum available fault current at that location. Include on the label the date that the fault calculation was performed and the contact information for the organization that completed the calculation. Locate this self-adhesive warning label on the outside of the switchgear. Provide label format as indicated.

2.9 MIMIC BUS LABELING

Provide a mimic bus on the front of the equipment to diagrammatically show the internal bus structure of the lineup.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2 and JIS C 0365 and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

IEEE C2 and JIS C 0365, except that grounds and grounding systems with a resistance to solid earth ground not exceeding \([25][\text{____}]\) ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.
3.2.2 Equipment Grounding

Provide bare copper cable not smaller than 100 sqmm not less than 610 mm below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

JIS C 60364-5-54, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchgear

JIS C 8201-1.

3.3.2 Meters and Instrument Transformers

JIS C 1210.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings per manufacturer's recommendations, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchgear on concrete slab as follows:

a. Unless otherwise indicated, provide the slab with dimensions at least 200 mm thick, reinforced with a 150 by 150 mm - MW19 by MW19 (6 by 6 - W2.9 by W2.9) mesh placed uniformly 100 mm from the top of the slab.
b. Place slab on a 150 mm thick, well-compacted gravel base.

c. Install slab such that the top of the concrete slab is approximately 100 mm above the finished grade.

d. Provide edges above grade with 15 mm chamfer.

e. Provide slab of adequate size to project at least 200 mm beyond the equipment.

f. Provide conduit turnups and cable entrance space required by the equipment to be mounted.

g. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.

h. Cut off and bush conduits 75 mm above slab surface.

i. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4.2 Interior Location

Mount switchgear on concrete slab as follows:

a. Unless otherwise indicated, provide the slab with dimensions at least 100 mm thick.

b. Install slab such that the top of the concrete slab is approximately 100 mm above the finished floor.

c. Provide edges above floor with 15 mm chamfer.

d. Provide slab of adequate size to project at least 200 mm beyond the equipment.

e. Provide conduit turnups and cable entrance space required by the equipment to be mounted.

f. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.

g. Cut off and bush conduits 75 mm above slab surface.

h. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

i. Provide duct sealing in conduits after cables are installed to prevent entrance of insects and moisture.

3.5 FIELD QUALITY CONTROL

[ Submit request for settings of breakers to the Contracting Officer after approval of switchgear and at least 30 days in advance of their requirement.

][Submit Required Settings of breakers to the Contracting Officer after approval of switchgear and at least 30 days in advance of their requirement.
3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with Denki Hoan Kyoukai.

3.5.1.1 Switchgear

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical, electrical, and mechanical condition.

(3) Verify appropriate anchorage, required area clearances, and correct alignment.

(4) Clean switchgear and verify shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.

(5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

(6) Verify that fuse and circuit breaker sizes and types correspond to approved shop drawings as well as to the circuit breaker’s address for microprocessor-communication packages.

(7) Verify that current transformer ratios correspond to approved shop drawings.

(8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(10) Confirm correct application of manufacturer's recommended lubricants.

(11) Inspect insulators for evidence of physical damage or contaminated surfaces.

(12) Verify correct barrier and shutter installation and operation.

(13) Exercise all active components.

(14) Inspect all mechanical indicating devices for correct operation.

(15) Verify that filters are in place and vents are clear.

(16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

(17) Inspect control power transformers.

b. Electrical Tests
(1) Perform insulation-resistance tests on each bus section.

(2) Perform dielectric withstand voltage tests.

(3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.

(4) Perform control wiring performance test.

(5) Perform primary current injection tests on the entire current circuit in each section of assembly.

(6) Perform phasing check on double-ended switchgear to ensure correct bus phasing from each source.

(7) Verify operation of switchgear heaters.

3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect anchorage, alignment, and grounding.

(4) Verify that all maintenance devices are available for servicing and operating the breaker.

(5) Inspect arc chutes.

(6) Inspect moving and stationary contacts for condition, wear, and alignment.

(7) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

(8) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

(9) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(10) Verify cell fit and element alignment.

(11) Verify racking mechanism.

(12) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests

(1) Perform contact-resistance tests on each breaker.
(2) Perform insulation-resistance tests.

(3) Adjust Breaker(s) for final settings in accordance with Government provided settings.

(4) Determine long-time minimum pickup current by primary current injection.

(5) Determine long-time delay by primary current injection.

[ (6) Determine short-time pickup and delay by primary current injection.

][ (7) Determine ground-fault pickup and delay by primary current injection.

][ (8) Determine instantaneous pickup value by primary current injection.

][ (9) Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.

} (10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

(11) Verify operation of charging mechanism.

3.5.1.3 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance tests.

(3) Perform polarity tests.
(4) Perform ratio-verification tests.

3.5.1.4 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.5 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) JIS C 60364-6. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Trip circuit
breakers by operation of each protective device. Test each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, provide the Contracting Officer 5 working days advance notice of the dates and times for checks, settings, and tests.

-- End of Section --
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SECTION 26 24 13

SWITCHBOARDS

05/15

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PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS), Ministry of Land, Infrastructure and Transport (MLIT), Japan Electrical Safety Inspection Associations or Japanese Architectural Standard Specifications (JASS) for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


JAPANESE ARCHITECTURAL STANDARD SPECIFICATIONS (JASS)


JAPAN ELECTRICAL SAFETY INSPECTION ASSOCIATIONS

Denki Hoan Kyoukai  Japan Standard for Acceptance Testing and Inspections

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS C 1210  (1979) General Rules for Electricity Meters


JIS C 5381-11  (2014) Low-voltage surge protective devices -- Part 11: Surge protective devices connected to low-voltage power
systems -- Requirements and test methods


JIS C 8269-2 (2013) Low voltage fuse-Part 2: Additional requirements for expert fuses(Mainly industrial fuses)

JIS C 8462-1 (2012) Boxes and enclosures for electrical accessories for household and similar fixed electrical installations -- Part 1: General requirements

JIS C 8480 (R2016) Box-Type Switchgear Assemblies for Low-Voltage Distribution Purpose


JIS C 60364-6 (2010) Low-voltage electrical installations -- Part 6: Verification

JIS C 61000-4-5 (2018) Electromagnetic compatibility-Part 4-5: Test and measurement techniques- Surge immunity test

JIS C 61558-1 (2019) Safety of transformers, reactors, power supply units and combinations thereof -- Part 1: General requirements and tests

JIS G 3352 (2014) Deck Plate

JIS G 3601 (2012) Stainless clad steel

JIS G 4304 (2012) Hot-Rolled Stainless Steel Plate, Sheet and Strip

JIS H 8641 (2007) Hot Dip Galvanized Coatings

JIS K 6911 (2006) Thermosetting plastic general test method


1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor QC approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29, SUSTAINABITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Switchboard Drawings; G[, [_____]]

SD-03 Product Data
   Switchboard; G[, [_____]]

SD-06 Test Reports
   Switchboard Design Tests;

SD-10 Operation and Maintenance Data
   Switchboard Operation and Maintenance, Data Package 5;

SD-11 Closeout Submittals
   Assembled Operation and Maintenance Manuals;
   Equipment Test Schedule;
   [ Request for Settings;
   ][ Required Settings;
   ]
   [ Service Entrance Available Fault Current Label;
1.5 QUALITY ASSURANCE

1.5.1 Product Data

Include manufacturer's information on each submittal for each component, device and accessory provided with the switchboard including:

a. Circuit breaker type, interrupting rating, and trip devices, including available settings.

b. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchboard Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

a. One-line diagram including breakers[, fuses][, current transformers, and meters].

b. Outline drawings including front elevation, section views, footprint, and overall dimensions.

c. Bus configuration including dimensions and ampere ratings of bus bars.

d. Markings and rated IP code nameplate data[, including fuse information (manufacturer's name, catalog number, and ratings)].

e. Circuit breaker type, interrupting rating, and trip devices, including available settings.

f. Wiring diagrams and elementary diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device. Use this information (designer of record) to provide breaker settings that ensures protection and coordination are achieved. [For Navy installations, provide electronic format curves using SKM’s Power Tools for Windows device library electronic format or EasyPower device library format depending on installation modeling software requirements.]

[ h. Provisions for future expansion by adding switchboard sections.]
1.5.3 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.5.4 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Switchboard Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.2 Assembled Operation and Maintenance Manuals

Assemble and securely bind manuals in durable, hard covered, water resistant binders. Assemble and index the manuals in the following order with a table of contents:

a. Manufacturer's O&M information required by the paragraph SD-10, OPERATION AND MAINTENANCE DATA.

b. Catalog data required by the paragraph SD-03, PRODUCT DATA.
c. Drawings required by the paragraph SD-02, SHOP DRAWINGS.

d. Prices for spare parts and supply list.

e. Information on metering.

f. Design test reports.

g. Production test reports.

[1.6.3] Spare Parts

Provide spare parts as specified below. Provide spare parts that are of the same material and workmanship, meet the same requirements, and are interchangeable with the corresponding original parts furnished.

a. Quantity 2 - Fuses of each type and size.

[ b. [_____]

]]1.7 WARRANTY

Provide equipment items that are supported by service organizations reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be switchboards and related accessories are specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 SWITCHBOARD

JIS C 8480.

2.2.1 Ratings

Provide equipment with the following ratings:

a. Voltage rating: [480Y/277]/[208Y/120]
   [440]/[440Y/254]/[420Y/242]/[220]/[210Y/105]/[___] volts AC, [50]/[60]
   hertz, [three-phase, [3]/[4]-wire]/[as indicated].

b. Continuous current rating of the main bus: [___] amperes/[as indicated].

c. Short-circuit current rating: [___] rms symmetrical amperes/[as indicated].

d. UL listed and labeled/[as service entrance equipment].

2.2.2 Construction

Provide the following:
a. Switchboard: consisting of one or more vertical sections[ bolted
together to form a rigid assembly] and [rear][front and rear] aligned[
as indicated].

b. All circuit breakers: front accessible.

c. Rear aligned switchboards: front accessible load connections.

[d. Front and rear aligned switchboards[: rear accessible load
connections].

] e. Where indicated, "space for future" or "space" means to include a
vertical bus provided behind a blank front cover. Where indicated,
"provision for future" means full hardware provided to mount a breaker
suitable for the location.

f. Completely factory engineered and assembled, including protective
devices and equipment indicated with necessary interconnections,
instrumentation, and control wiring.

2.2.2.1 Enclosure

Provide the following:

a. Enclosure: [indoor][weatherproof] IP rated per JIS C 8462-1[as
indicated][ fabricated entirely of 12 gauge, type 304 or 304L stainless
steel] per JIS G 3601 and JIS G 4304.

b. Enclosure: bolted together with removable bolt-on side and[ hinged]
rear covers[, and sloping roof downward toward rear].

c. Front[ and rear] doors: provided with[ stainless steel] padlockable
vault handles with a three point catch.

[d. Bases, frames and channels of enclosure: corrosion resistant and
fabricated of[ type 304 or 304L stainless steel][ or][ galvanized steel]
JIS G 3601 and JIS G 4304.

] e. Base: includes any part of enclosure that is within 75 mm of concrete
pad.

f. Galvanized steel: JIS H 8641 and JIS G 3352 coating, and JIS B 1048
and JIS H 8641, as applicable. Galvanize after fabrication where
practicable.

g. Paint color: light gray over rust inhibitor.

h. Paint coating system: comply with[ JIS C 8480 for galvanized steel][
and][ JIS Z 2371 for stainless steel].

2.2.2.2 Bus Bars

Provide the following:

a. Bus bars: [copper with silver-plated contact surfaces][ or][aluminum
with tin-plated contact surfaces].

(1) Phase bus bars: [ uninsulated][insulated with a tape wrap or
insulating sleeve providing a minimum breakdown voltage in
accordance with JIS C 2110-1).

(2) Neutral bus: rated [100][_____] percent of the main bus continuous current rating[ as indicated].

b. Make bus connections and joints with hardened steel bolts.

c. Main-bus (through bus): rated at the full ampacity of the main throughout the switchboard.

d. Minimum 6.35 mm by 50.8 mm copper ground bus secured to each vertical section along the entire length of the switchboard.

2.2.2.3 Main Section

Provide the main section consisting of [a combination section with molded-case circuit breakers] for the [main and] branch devices as indicated [main lugs only][ an individually mounted [fixed] air power circuit breaker[ with current-limiting fuses]][ insulated-case circuit breaker][ molded-case circuit breaker][ and utility transformer compartment].

[2.2.2.4 Distribution Sections]

Provide the distribution section[s] consisting of [individually mounted,] [air power circuit breakers[ with current-limiting fuses]][ insulated-case circuit breakers][ molded-case circuit breakers][ and utility transformer compartments] as indicated.

[2.2.2.5 Auxiliary Sections]

Provide auxiliary sections consisting of indicated [instruments,][ metering equipment,][ control equipment,][ transformer,][ and][ current transformer compartments] as indicated.

[2.2.2.6 Handles]

Provide handles for individually mounted devices of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

2.2.3 Protective Device

Provide [main and] branch protective devices as indicated.

[2.2.3.1 Power Circuit Breaker]

Provide the following:

a. JIS C 8201-2-1 and JIS C 8201-2-2. [120 Vac][100 Vac][ electrically][ manually] operated [stationary], [unfused][fused], low-voltage power circuit breaker with a short-circuit current rating[ of [_____] rms amperes symmetrical][ as indicated] at [_____] volts.

b. Breaker frame size: [ as indicated][ [_____] amperes].

c. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker.
against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle.

][2.2.3.2 Insulated-Case Breaker

Provide the following:

a. JIS C 8201-2-1. UL listed and labeled, [100 percent rated main breaker] [standard rated branch breakers], [electrically] [manually] operated, low voltage, insulated-case circuit breaker, with a short-circuit current rating of [_____] rms symmetrical amperes [as indicated] at [_____] volts.

b. Breaker frame size: [_____] amperes [as indicated].

c. Series rated circuit breakers are unacceptable.

][2.2.3.3 Molded-Case Circuit Breaker

Provide the following:

a. JIS C 8201-2-1. UL listed and labeled, [100 percent rated main breaker] [standard rated branch breakers], [electrically] [manually] operated, low voltage molded-case circuit breaker, with a short-circuit current rating of [_____] rms symmetrical amperes [as indicated] at [_____] volts.

b. Breaker frame size: [_____] amperes [as indicated].

c. Series rated circuit breakers are unacceptable.

][2.2.3.4 Fusible Switches

Provide the following:


b. Switches serving as motor disconnects: horsepower rated.


d. Fuseholders: [JIS C 8269-1 and JIS C 8269-2].

][2.2.3.5 Integral Combination Breaker and Current-Limiting Fuses

Provide the following:

a. JIS C 8201-2-1.

b. Integral combination molded-case circuit breaker and current-limiting fuses: [as indicated] [rated [_____] amperes] with a minimum short-circuit-current rating equal to the short-circuit-current rating of the switchboard in which the circuit breaker will be mounted.

c. Series rated circuit breakers are unacceptable.

d. Coordination of overcurrent devices of the circuit breaker and current-limiting fuses: for overloads or fault currents of relatively
low value, the overcurrent device of the breaker operates to clear the fault. The current-limiting fuses operate to clear the fault for high magnitude short circuits above a predetermined value[crossover point].

e. Housing for the current-limiting fuses: an individual molding readily removable from the front and located at the load side of the circuit breaker. If the fuse housing is removed, a blown fuse is readily evident by means of a visible indicator.

f. Removal of fuse housing causes the breaker contacts to open, and the breaker contacts can not close with the fuse housing removed. The fuse housing can not be inserted with a blown fuse or with one fuse missing. The blowing of any of the fuses causes the circuit breaker contacts to open.

2.2.4 Electronic Trip Units

Equip[main and][distribution] breakers[as indicated] with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

a. Current sensors ampere rating: [as indicated][_____] amperes][the same as the breaker frame rating].

b. Trip unit ampere rating: [as indicated][_____] amperes].

c. Ground fault protection: [as indicated][zero sequence sensing][residual type sensing].

d. Electronic trip units: provide additional features[as indicated]:

(1) [Indicated ]Breakers: include long delay pick-up and time settings, and LED indication of cause of circuit breaker trip.

(2) Main breakers: include[short delay pick-up and time settings][and][, instantaneous settings][and][ground fault settings][as indicated].

(3) Distribution breakers: include[short delay pick-up and time settings][, instantaneous settings][, and ground fault settings][as indicated].

(4) [Main ]Breakers: include a digital display for phase and ground current.

(5) [Main ]Breakers: include a digital display for watts, vars, VA, kWh, kvarh, and kVArh.

(6) [Main ]Breakers: include a digital display for phase voltage, and percent THD voltage and current.

(7) [Main ]Breakers: include provisions for communication via a network twisted pair cable for remote monitoring and control. Provide the following communications protocol:[DNP3][Modbus][IEC 61850].

(8) For electronic trip units that are rated for or can be adjusted to 1,200 amperes or higher, provide arc energy reduction capability.
with an energy-reducing maintenance switch with local status indicator.

][2.2.5 Metering

[2.2.5.1 Digital Meters

[JIS C 5381-11 and JIS C 61000-4-5 for surge withstand. [Metering shall be compliant with the current Advanced Meter Reading System (AMRS) specification.] Provide true rms, plus/minus one percent accuracy, programmable, microprocessor-based meter enclosed in a sealed case with the following features.]

[Provide meter(s) and connect the meter(s) to the existing Advanced Meter Infrastructure Data Acquisition System (AMI DAS). The contractor shall use the existing government laptop computers to configure the meter using existing software loaded on the computer. The contractor will not be allowed to modify any software or add any additional software to the computer. Alternatively, the government will configure the meter(s), which must be compatible with the existing system, using existing software. Contract shall insure that the meter(s) will transmit the specified data to the DAS. Meters shall be compatible with the Base AMI DAS per NAVFAC Far East requirements.]

a. Display capability:

[ (1) Multi-Function Meter: Display a selected phase to neutral voltage, phase to phase voltage, percent phase to neutral voltage THD, percent phase to phase voltage THD; a selected phase current, neutral current, percent phase current THD, percent neutral current; selected total PF, kW, kVA, kVAR, FREQ, kVAh, kWh. Detected alarm conditions include over/under current, over/under voltage, over/under kVA, over/under frequency, over/under selected PF/kVAR, voltage phase reversal, voltage imbalance, reverse power, over percent THD. Include a Form C KYZ pulse output relay on the meter.

] (2) Power Meter: Display Watts, VARs, and selected KVA/PF. Detected alarm conditions include over/under kVA, over/under PF, over/under VARs, over/under reverse power.

][ (3) Volt Meter: Provide capability to be selectable between display of the three phases of phase to neutral voltages and display of the three phases of the phase to phase voltages. Detected alarm conditions include over/under voltage, over/under voltage imbalance, over percent THD.

][ (4) Ammeter: Display phase A, B, and C currents. Detected alarm conditions include over/under current, over percent THD.

][ (5) Digital Watthour Meter: Provide a single selectable display for watts, total kilowatt hours (kWh) and watt demand (Wd). Include a Form C KYZ pulse output relay on the meter.

] b. Design meters to accept[ input from standard 5A secondary instrument transformers][ and][ direct voltage monitoring range to [300][600] volts, phase to phase].

c. Provide programming via a front panel display and a communication
interface accessible by a computer.

d. Provide password secured programming stored in non-volatile EEPROM memory.


f. Provide meter that calculates and stores average max/min demand values with time and date for all readings based on a user selectable sliding window averaging period.

g. Provide meter with programmable hi/low set limits with two dry contact relays when exceeding alarm conditions.

h. Meter shall have two-way communication with the existing DAS. Provide a communications interface utilizing fiber-optic LC connection.

2.2.5.2 Electronic Watthour Meter

[ JIS C 1210. Provide a switchboard style electronic programmable watthour meter, semi-flush mounted, as indicated. Meter can be either programmed at the factory or programmed in the field. Turn field programming device over to the Contracting Officer at completion of project. Coordinate meter to system requirements.

a. Design: Provide meter designed for use on a 3-phase, 4-wire, [208Y/120] [210Y/105][480Y/277][440Y/254][420Y/242] volt system with 3 current transformers. Include necessary KYZ pulse initiation hardware for Energy Monitoring and Control System (EMCS).

b. Coordination: Provide meter coordinated with ratios of current transformers and transformer secondary voltage.

c. Class: 20. Accuracy: plus or minus 1.0 percent. Finish: Class II.

d. Kilowatt-hour Register: five digit electronic programmable type.

e. Demand Register:

(1) Provide solid state.

(2) Meter reading multiplier: Indicate multiplier on the meter face.

(3) Demand interval length: programmed for [15][30][60] minutes with rolling demand up to six subintervals per interval.

f. Meter fusing: Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to the watthour meter. Size fuses as recommended by the meter manufacturer.

g. Provide meter with a communications port, RS485, with Modbus RTU serial or Ethernet, Modbus-TCP communications.

JIS C 1731-1. Provide single ratio transformers, [60 hertz][50 hertz], [_____] to 5-ampere ratio, [_____] rating factor, with a metering accuracy class of 0.3 through [_____.]
[ Provide a fuse block mounted in the metering compartment containing one fuse per phase to protect the voltage input to voltage sensing meters. Size fuses as recommended by the meter manufacturer. ]

[[2.2.5.3 Submetering]]

Provide submetering for [_____] [in accordance with drawings].

[[2.2.6 Transformer]]

Provide transformer section in switchboard in accordance with JIS C 8480 and as indicated. Provide the transformer and section that is suitable for the installation. [ Test transformers greater than 10 kVA in accordance with JIS C 8480.] Provide a transformer conforming to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

[[2.2.7 Heaters]]

Provide [120-volt][100-volt] heaters in each switchboard section. Provide heaters of sufficient capacity to control moisture condensation in the section, 250 watts minimum, and controlled by a thermostat[ and humidistat] located in the section. Provide industrial type thermostat, high limit, to maintain sections within the range of 15 to 32 degrees C. [ Provide humidistat with a range of 30 to 60 percent relative humidity.] Obtain supply voltage for the heaters from a control power transformer within the switchboard. If heater voltage is different than switchboard voltage, provide transformer rated to carry 125 percent of heater full load rating. Provide transformer with a 220 degrees C insulation system with a temperature rise not exceeding 115 degrees C and conforming to JIS C 61558-1. [ Energize electric heaters in switchboard assemblies while the equipment is in storage or in place prior to being placed in service. Provide method for easy connection of heater to external power source. Provide temporary, reliable external power source if commercial power at rated voltage is not available on site.]

[[2.2.8 Terminal Boards]]

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Provide short-circuiting type terminal boards associated with current transformer. Terminate conductors for current transformers with ring-tongue lugs. Provide terminal board identification that is identical in similar units. Provide color coded external wiring that is color coded consistently for similar terminal boards.

2.2.9 Wire Marking

Mark control and metering conductors at each end. Provide factory installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Provide a single letter or number on each sleeve, elliptically shaped to securely grip the wire, and keyed in such a manner to ensure alignment with adjacent sleeves. Provide specific wire markings using the appropriate combination of individual sleeves. Indicate on each wire marker the device or equipment, including specific terminal number to which the remote end of the wire is attached.
2.3 MANUFACTURER'S NAMEPLATE

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable. This nameplate and method of attachment may be the manufacturer's standard if it contains the required information.

2.4 FIELD FABRICATED NAMEPLATES

JIS K 6911. Provide laminated plastic nameplates for each switchboard, equipment enclosure, relay, switch, and device; as specified in this section or as indicated on the drawings. Identify on each nameplate inscription the function and, when applicable, the position. Provide nameplates of melamine plastic, 3 mm thick, white with [black] center core. Provide red laminated plastic label with white center core where indicated. Provide matte finish surface. Provide square corners. Accurately align lettering and engrave into the core. Provide nameplates with minimum size of 25 by 65 mm. Provide lettering that is a minimum of 6.35 mm high normal block style.

2.5 SOURCE QUALITY CONTROL

2.5.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date.

Provide the following as part of test equipment calibration:

a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

b. Accuracy: Traceable to the National Institute of Standards and Technology.

c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.

d. Dated calibration labels: visible on all test equipment.

e. Calibrating standard: higher accuracy than that of the instrument tested.

f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

   (1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

   (2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.
2.5.2 Switchboard Design Tests

JIS C 8480.

2.5.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current test.

b. Enclosure tests.

c. Dielectric test.

[2.5.2.2 Additional Design Tests]

In addition to normal design tests, perform the following tests on the actual equipment. Furnish reports which include results of design tests performed on the actual equipment.

a. Temperature rise tests.

b. Continuous current.

2.5.3 Switchboard Production Tests

JIS C 8480. Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

a. [60-hertz][50-hertz] dielectric tests.

b. Mechanical operation tests.

c. Electrical operation and control wiring tests.

d. Ground fault sensing equipment test.

[2.6 COORDINATED POWER SYSTEM PROTECTION]

Provide a power system study as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

[2.7 ARC FLASH WARNING LABEL]

Provide warning label of potential electrical arc flash hazards for switchboards in accordance with NFPA 70E and JIS Z 9101.

[2.8 SERVICE ENTRANCE AVAILABLE FAULT CURRENT LABEL]

Provide label on exterior of switchboards used as service equipment listing the fault current rating in accordance with NFPA 70E and JIS Z 9101. Locate this self-adhesive warning label on the outside of the switchboard.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to IEEE C2, JIS C 0365 and to the requirements specified herein.
Provide new equipment and materials unless indicated or specified otherwise.

3.2 GROUNDING

IEEE C2 and JIS C 0365, except that grounds and grounding systems with a resistance to solid earth ground not exceeding [25][_____] ohms.

3.2.1 Grounding Electrodes

Provide driven ground rods as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Connect ground conductors to the upper end of the ground rods by exothermic weld or compression connector. Provide compression connectors at equipment end of ground conductors.

3.2.2 Equipment Grounding

Provide bare copper cable not smaller than [100 sqmm] not less than 610 mm below grade connecting to the indicated ground rods. When work in addition to that indicated or specified is directed to obtain the specified ground resistance, the provision of the contract covering "Changes" applies.

3.2.3 Connections

Make joints in grounding conductors and loops by exothermic weld or compression connector. Install exothermic welds and compression connectors as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.2.4 Grounding and Bonding Equipment

JIS C 60364-5-54, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect equipment furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchboard

JIS C 8480.

3.3.2 Meters and Instrument Transformers

JIS C 1210.

3.3.3 Field Applied Painting

Where field painting of enclosures is required to correct damage to the manufacturer's factory applied coatings, provide manufacturer's recommended coatings and apply in accordance with manufacturer's instructions.

3.3.4 Galvanizing Repair

Repair damage to galvanized coatings using JASS 6, zinc rich paint, for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.3.5 Field Fabricated Nameplate Mounting

Provide number, location, and letter designation of nameplates as
indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Exterior Location

Mount switchboard on concrete slab as follows:

a. Unless otherwise indicated, provide the slab with dimensions at least 200 mm thick, reinforced with a 150 by 150 mm – MW19 by MW19 (6 by 6 – W2.9 by W2.9) mesh placed uniformly 100 mm from the top of the slab.

b. Place slab on a 150 mm thick, well-compacted gravel base.

c. Install slab such that the top of the concrete slab is approximately 100 mm above the finished grade.

d. Provide edges above grade with 15 mm chamfer.

e. Provide slab of adequate size to project at least 200 mm beyond the equipment.

f. Provide conduit turnups and cable entrance space required by the equipment to be mounted.

g. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.

h. Cut off and bush conduits 75 mm above slab surface.

i. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.4.2 Interior Location

Mount switchboard on concrete slab as follows:

a. Unless otherwise indicated, provide the slab with dimensions at least 100 mm thick.

b. Install slab such that the top of the concrete slab is approximately 100 mm above the finished grade.

c. Provide edges above grade with 15 mm chamfer.

d. Provide slab of adequate size to project at least 200 mm beyond the equipment.

e. Provide conduit turnups and cable entrance space required by the equipment to be mounted.

f. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant.

g. Cut off and bush conduits 75 mm above slab surface.

h. Provide concrete work as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.
3.5 FIELD QUALITY CONTROL

[Submit request for settings of breakers to the Contracting Officer after approval of switchboard and at least 30 days in advance of their requirement.

][Submit Required Settings of breakers to the Contracting Officer after approval of switchboard and at least 30 days in advance of their requirement.

]3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with Denki Hoan Kyoukai.

3.5.1.1 Switchboard Assemblies

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical, electrical, and mechanical condition.

(3) Verify appropriate anchorage, required area clearances, and correct alignment.

(4) Clean switchboard and verify shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.

(5) Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

(6) Verify that fuse and circuit breaker sizes and types correspond to approved shop drawings as well as to the circuit breaker’s address for microprocessor-communication packages.

[7] Verify that current transformer ratios correspond to approved shop drawings.

(8) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(9) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(10) Confirm correct application of manufacturer's recommended lubricants.

(11) Inspect insulators for evidence of physical damage or contaminated surfaces.

(12) Verify correct barrier installation[ and operation].

(13) Exercise all active components.
(14) Inspect all mechanical indicating devices for correct operation.

(15) Verify that filters are in place and vents are clear.

(16) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

(17) Inspect control power transformers.

b. Electrical Tests

(1) Perform insulation-resistance tests on each bus section.

(2) Perform dielectric withstand voltage tests.

(3) Perform insulation-resistance test on control wiring; Do not perform this test on wiring connected to solid-state components.

(4) Perform control wiring performance test.

(5) Perform primary current injection tests on the entire current circuit in each section of assembly.

(6) Perform phasing check on double-ended switchboard to ensure correct bus phasing from each source.

(7) Verify operation of switchboard heaters.

3.5.1.2 Circuit Breakers - Low Voltage - Power

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Inspect anchorage, alignment, and grounding.

(4) Verify that all maintenance devices are available for servicing and operating the breaker.

(5) Inspect arc chutes.

(6) Inspect moving and stationary contacts for condition, wear, and alignment.

(7) Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

(8) Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism.

(9) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.
(10) Verify cell fit and element alignment.

(11) Verify racking mechanism.

(12) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests

(1) Perform contact-resistance tests on each breaker.

(2) Perform insulation-resistance tests.

(3) Adjust Breaker(s) for final settings in accordance with Government provided settings.

(4) Determine long-time minimum pickup current by primary current injection.

(5) Determine long-time delay by primary current injection.

(6) Determine short-time pickup and delay by primary current injection.

(7) Determine ground-fault pickup and delay by primary current injection.

(8) Determine instantaneous pickup value by primary current injection.

(9) Activate auxiliary protective devices, such as ground-fault or undervoltage relays, to ensure operation of shunt trip devices; Check the operation of electrically-operated breakers in their cubicle.

(10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.

(11) Verify operation of charging mechanism.

3.5.1.3 Circuit Breakers

[Low Voltage - Insulated-Case] and [Low Voltage Molded Case with Solid State Trips]

a. Visual and Mechanical Inspection

(1) Compare nameplate data with specifications and approved shop drawings.

(2) Inspect circuit breaker for correct mounting.

(3) Operate circuit breaker to ensure smooth operation.

(4) Inspect case for cracks or other defects.

(5) Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated...
torque-wrench method, or performing thermographic survey.

(6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

(1) Perform contact-resistance tests.

(2) Perform insulation-resistance tests.

(3) Perform Breaker adjustments for final settings in accordance with Government provided settings.

(4) Perform long-time delay time-current characteristic tests

(5) Determine short-time pickup and delay by primary current injection.

(6) Determine ground-fault pickup and time delay by primary current injection.

(7) Determine instantaneous pickup current by primary injection.

(8) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.

3.5.1.4 Current Transformers

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify correct connection.

(4) Verify that adequate clearances exist between primary and secondary circuit.

(5) Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey.

(6) Verify that all required grounding and shorting connections provide good contact.

b. Electrical Tests

(1) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

(2) Perform insulation-resistance tests.

(3) Perform polarity tests.

(4) Perform ratio-verification tests.
3.5.1.5 Metering and Instrumentation

a. Visual and Mechanical Inspection

(1) Compare equipment nameplate data with specifications and approved shop drawings.

(2) Inspect physical and mechanical condition.

(3) Verify tightness of electrical connections.

b. Electrical Tests

(1) Determine accuracy of meters at 25, 50, 75, and 100 percent of full scale.

(2) Calibrate watthour meters according to manufacturer's published data.

(3) Verify all instrument multipliers.

(4) Electrically confirm that current transformer and voltage transformer secondary circuits are intact.

3.5.1.6 Grounding System

a. Visual and Mechanical Inspection

(1) Inspect ground system for compliance with contract plans and specifications.

b. Electrical Tests

(1) JIS C 60364-6. Perform ground-impedance measurements utilizing the fall-of-potential method. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. Use an instrument equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test.

(2) Submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system. Include the test method and test setup (i.e., pin location) used to determine ground resistance and soil conditions at the time the measurements were made.

3.5.2 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Trip circuit
breakers by operation of each protective device. Test each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, provide the Contracting Officer 5 working days advance notice of the dates and times for checks, settings, and tests.

-- End of Section --
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PART 1 GENERAL

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SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS), Japan Luminaires Association (JIL) as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

JAPANESE INDUSTRIAL STANDARDS (JIS)


JIS C 8117 (2008) AC supplied electronic ballasts for fluorescent lamps


JIS C 8153 (2015) DC or AC supplied electronic control gear for LED modules --
Performance requirements

JIS C 8154  (2015) LED modules for general lighting -- Safety specifications

JIS C 8155  (2019) LED modules for general lighting -- Performance requirements

JIS C 8201-4-1  (2010) Low-voltage switchgear and controlgear -- Part 4-1: Contactors and motor-starters: Electromechanical contactors and motor-starters


JIS C 8286  (2013) Electrical accessories -- Cord sets and interconnection cord sets

JIS C 8304  (2009) Small switches for indoor use

JIS C 8462-1  (2012) Boxes and enclosures for electrical accessories for household and similar fixed electrical installations -- Part 1: General requirements

JIS C 5381-11  (2014) Low-voltage surge protective devices -- Part 11: Surge protective devices connected to low-voltage power systems -- Requirements and test methods

JIS C 5381-12  (2014) Low-voltage surge protective devices -- Part 12: Surge protective devices connected to low-voltage power distribution systems -- Selection and application principles


JIS C 60079-0  (2010) Explosive atmospheres -- Part 0: Equipment -- General requirements

JIS C 61000-3-2  (2019) Electromagnetic compatibility (EMC) -- Part 3-2: Limits -- Limits for harmonic current emissions

JIS C 9730-2-7  (2019) Automatic electrical controls -- Part 2-7: Particular requirements for timers and time switches

JIS G 3141  (2017) Cold-reduced carbon steel sheet and strip
1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires or luminaire accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires and accessories mounted on exterior surfaces of buildings are specified in Section 26 56 00 EXTERIOR LIGHTING.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, must be as defined in JIS Z 8113
1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the JIS Z 9110 as applicable, for the lighting system specified. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Occupancy/Vacancy Sensor Coverage Layout;

SD-03 Product Data

Luminaires; G[, [_____]]
Light Sources; G[, [_____]]
Drivers, Ballasts and Generators; G[, [_____]]
LED Luminaire Warranty;
Vacancy Sensors; G[, [_____]]
Dimming Controllers (Dimmers); G[, [_____]]
Lighting Contactor; G[, [_____]]
Timeswitch; G[, [_____]]
Power Hook Luminaire Hangers; G[, [_____]]
Exit Signs; G[, [_____]]
Emergency Lighting Unit (EBU); G[, [_____]]
LED Emergency Drivers; G[, [_____]]
Fluorescent Emergency Ballasts; G[, [_____]]
Occupancy Sensors; G[, [_____]]
Ambient Light Level Sensor ; G[, [_____]]
Lighting Control Panel; G[, [_____]]

SD-06 Test Reports

Occupancy/Vacancy Sensor Verification Tests;
Energy Efficiency;
1.5 QUALITY CONTROL

1.5.1 Luminaire Drawings

Include dimensions, accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data must accompany shop drawings.

1.5.2 Occupancy/Vacancy Sensor Coverage Layout

Provide floor plans showing coverage layouts of all devices using manufacturer's product information.

1.5.3 Luminaire Design Data

Provide long term lumen maintenance projections for each LED luminaire in accordance with JIS C 8152-3. Data used for projections must be obtained from testing in accordance with JIS C 8152-3 Appendix B.

1.5.4 LED Luminaire - Test Report

Submit test report on manufacturer's standard production model luminaire.

1.5.5 LED Light Source - Test Report

Submit test report on manufacturer's standard production LED light source (package, array or module). Include all applicable and required data, as outlined under "8 Report on Test Results" in JIS C 8152-3.

1.5.6 Occupancy/Vacancy Sensor Verification Tests

Submit test report outlining post-installation coverage and operation of sensors.

1.5.7 Test Laboratories

Test laboratories for JIS C 8152-2 and JIS C 8152-3 test reports must be a Japan Accredited Laboratory for solid-state lighting testing as part of the Energy-Efficient Lighting Products laboratory accreditation program for both LM-79 and LM-80 or JIS C 8152-2 and JIS C 8152-3 testing.

1.5.8 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of applicable codes and standards, unless more stringent requirements are specified or indicated.

1.5.9 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period must include applications of equipment and materials under
similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.9.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.9.2 Material and Equipment Manufacturing Date

Products manufactured more than six months prior to date of delivery to site must not be used, unless specified otherwise.

1.5.9.3 Energy Efficiency

Submit data indicating lumens per watt efficacy and color rendering index of light source.

1.6 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 LED Luminaire Warranty

a. Provide a written 5 year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

   (1) Include finish warranty to include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

   (2) Material warranty must include:

      (a) All drivers.

      (b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

b. Warranty period must begin on date of beneficial occupancy. Provide the Contracting Officer with signed warranty certificates prior to final payment.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, luminaire controls, or associated equipment are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Luminaires, luminaire controls, and associated
equipment for exterior applications are specified in Section 26 56 00 EXTERIOR LIGHTING.

2.2 LUMINAIRÉS

JIS C 8105-1, JIS C 61000-3-2 JIS C 8154 and JIS C 8155. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer. Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

2.2.1 LED Luminaires

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

<table>
<thead>
<tr>
<th>LUMINAIRE TYPE</th>
<th>MINIMUM LUMINAIRE EFFICACY (LE)</th>
<th>MINIMUM COLOR RENDERING INDEX (CRI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED TROFFER -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300 x 1200</td>
<td>90 LPW</td>
<td>80</td>
</tr>
<tr>
<td>600 x 600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600 x 1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED Downlight</td>
<td>50 LPW</td>
<td>90</td>
</tr>
<tr>
<td>LED Track or Accent</td>
<td>40 LPW</td>
<td>80</td>
</tr>
<tr>
<td>LED Low Bay/High Bay</td>
<td>80 LPW</td>
<td>70</td>
</tr>
<tr>
<td>LED Linear Ambient</td>
<td>80 LPW</td>
<td>80</td>
</tr>
</tbody>
</table>

LED luminaires must also meet the following minimum requirements:

a. Luminaires must have a minimum 5 year manufacturer's warranty.

b. Luminaires must have a minimum [_____] lumen maintenance value of [_____] hours as calculated by JIS C 8152-3, with data obtained per JIS C 8152-3 requirements.

c. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. Luminaires must be tested to JIS C 8152-2 and JIS C 8152-3, with the results provided as required in the Submittals paragraph of this specification.

2.2.2 Fluorescent Luminaires

JIS C 8105-1 and JIL 4003. Provide linear and compact fluorescent luminaires complete with housing, ballast and light source. All fluorescent luminaires must be equipped with electronic ballasts.

2.2.3 Induction Luminaires

JIS C 8105-1. Provide induction luminaires complete with housing, generator and light source.
2.2.4 Luminaires for Hazardous Locations

In addition to requirements stated herein, provide [LED,][fluorescent,][HID,][induction] luminaires for hazardous locations which conform to JIS C 60079-0 or which have Factory Mutual certification for the class and division indicated.

2.3 DRIVERS, BALLASTS and GENERATORS

2.3.1 LED Drivers

JIS C 8153, JIS C 8154 and JIS C 8155. LED drivers must be electronic, constant-current type and comply with the following requirements:

a. Output power (watts) and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.

b. Power Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.

c. Current draw Total Harmonic Distortion (THD) of less than 20 percent.

d. Class A sound rating.

e. Operable at input voltage of [120][240][120-277][105][210] volts at [50][60] hertz.

f. Minimum 5 year manufacturer's warranty.

g. RoHS compliant.

h. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.

i. UL listed for dry or damp locations typical of interior installations.

j. [Non-dimmable], [step-dimmable to 50 percent output], or fully-dimmable using 0-10V control as indicated in luminaire schedule.

2.3.2 Fluorescent Electronic Ballasts

JIS C 8117. Fluorescent ballasts must not contain any magnetic core and coil components, and must meet the following requirements:

a. Provide with protection as recommended by JIS C 5381-11 and JIS C 5381-12.

b. Be designed for the wattage and type of light source provided in the luminaire specified, and have circuit diagrams and light source connection information printed on the exterior of the ballast housing.

c. Have a full replacement warranty of five years from date of manufacture.

d. Provide all fluorescent ballasts as highest-efficiency type.

2.3.2.1 T8 Programmed[Instant]-Start Fluorescent Ballasts

Provide programmed[ instant]-start T8 electronic fluorescent ballasts with
the following characteristics:

a. Total harmonic distortion (THD): Must be [20 percent] [_____ percent] (maximum).

b. Input wattage at [120/277][105][210] volts.

[c. Where indicated on project drawings, provide multi-light source luminaires with two or more ballasts to accomplish the switching scenario indicated.

[d. A single ballast may be used to serve multiple luminaires if they are continuously mounted and factory manufactured for that installation with an integral wireway.

] 2.3.2.2  T5 (long twin tube) and T5HO Fluorescent Ballasts

a. Total harmonic distortion (THD): Not greater than [25 percent when operating one light source,][15 percent when operating two light sources,][ and][20 percent when operating three light sources].

b. Input wattage shall be per Annex B, JIS C 8117

[c. Provide three[ and four] light source luminaires with two ballasts per luminaire where multilevel switching is indicated.

[d. A single ballast may be used to serve multiple fixtures if they are continuously mounted and factory manufactured for that installation with an integral wireway.

] 2.3.2.3  Compact Fluorescent Ballasts

Provide programmed-start ballasts for compact fluorescent luminaires.

2.3.2.4  Fluorescent Electronic Dimming Ballasts

Provide fluorescent electronic dimming ballasts with the following characteristics:

a. Comply with JIS C 8117 and JIL 4003, unless specified otherwise. Provide ballast as recommended by JIS C 5381-11 and JIS C 5381-12. Provide dimming capability range from 100 to 5 percent (minimum range) of light output, flicker free. Ballast must start lamp at any preset light output setting without first having to go to full light output. Provide ballasts designed for the wattage of the light sources used in the indicated application. Provide ballasts designed to operate on the voltage system to which they are connected.

a. Ballast must be capable of starting and maintaining operation at a minimum of minus 17 degrees C unless otherwise indicated.

b. Ballasts for T-5 and smaller light sources must have protection circuits as required by JIS C 7617-1 and JIS C 7620-1 as applicable.

2.3.2.4.1  T-8 Lamp Ballast

Input wattage shall be per Annex B, JIS C 8117
2.3.3 Induction Generators

Generator must be connected, and operate in conjunction with an inductive power coupler or coil(s). Provide solid-state, high-frequency (200 kHz - 2.67 MHz) type, with power factor greater than 0.95, Class A sound rating, maximum input current THD of 15 percent, operating voltage of [105-210][120-240][120-277]V, and a minimum starting temperature of minus 30 degrees F. Provide generator dimmable to a minimum of 50 percent light output.

2.4 LIGHT SOURCES

JIS C 8155. Provide type and wattage as indicated in luminaire schedule on project plans.

2.4.1 LED Light Sources

a. Correlated Color Temperature (CCT) of [3000]3500[4000][_____] degrees K.

b. Minimum Color Rendering Index (CRI) value of 80.

c. High power, white light output utilizing phosphor conversion (PC) process[ or mixed system of colored LEDs, typically red, green and blue (RGB)].

d. RoHS compliant.

2.4.1.1 LED Retrofit T8 Tubes

Provide linear T8 tubular LED light sources to replace fluorescent light sources in renovation or energy conservation projects. Provide only where entire luminaires are not being replaced. Light sources must be compatible with existing instant-start or programmed-start ballasts and have the following requirements:

a. Correlated Color Temperature (CCT) of [3000]3500[4000] degrees K.

b. Total Harmonic Distortion (THD) less than 20 percent, with Power Factor (PF) greater than 90 percent.

c. Minimum lumen per watt efficacy greater than 120.

d. Minimum beam angle of 180 degrees.

e. Minimum 5 year warranty.

f. Minimum Color Rendering Index (CRI) of 80.

2.4.2 Fluorescent Light Sources

JIS Z 9112. Fluorescent light sources must be low-mercury, energy-savings type and be compliant with the most current TCLP test procedure at the time of manufacture.

2.4.2.1 Linear Fluorescent Light Sources

JIS C 7617-1. Provide linear fluorescent light sources with minimum CRI of 85[_____] and CCT of 3500[_____] degrees K.
2.4.2.1.1 T8 Linear Fluorescent Light Sources

Provide T8 light sources with medium bi-pin base, rated [_____] watts (maximum), [_____] initial lumens (minimum), and with an average rated life of 30,000[_____] hours using a average three hour burn time and programmed-start ballast.

2.4.2.1.2 T5HO (High-Output) Linear Fluorescent Light Sources

Provide T5HO light sources with miniature bi-pin base, rated [_____] watts (maximum), [_____] initial lumens (minimum), and with an average rated life of 30,000[_____] hours using a average three hour burn time and programmed start ballast.

2.4.2.2 Compact Fluorescent (CFL) Light Sources

JIS C 7620-1. Provide compact fluorescent (CFL) light sources with minimum CRI of 82[_____] and CCT of 3500[_____] degrees K.

2.4.3 Induction Light Sources

Provide induction light sources consisting of an electrodeless, inductively-coupled, phosphor-coated fluorescent envelope, with an average rated life of 100,000 hours minimum rated using three hours operation per start. Light sources must be compliant with the most current TCLP test procedure at the time of manufacture.

2.5 LIGHTING CONTROLS

Provide lighting controls and associated equipment in accordance with drawings and applicable energy codes. [Provide network certification for all networked lighting control systems and devices per requirements of Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.]

2.5.1 Toggle Switches

Provide line-voltage toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.5.2 Dimming Controllers (Dimmers)

JIS C 8304. [120/277][105/210] V[0-10 V] dimmers must provide flicker-free, continuously variable light output throughout the dimming range. Provide radio frequency interference suppression integral to device. Provide dimmers utilizing [pulse width modulation (PWM)][constant current reduction (CCR) technology]. Provide device with a vertical slider, paddle, rotary button, or toggle (with adjacent vertical slider) type control, with finish to match switches and outlets in same area. Provide back box in wall with sufficient depth to accommodate body of switch and wiring. Devices must be capable of operating at their full rated capacity regardless of being single or ganged-mounted, and be compatible with three-way and four-way switching scenarios. Dimmers must be capable of controlling [two-wire][three-wire][0-10 volt] fluorescent ballasts or LED drivers. Ensure compatibility of dimmer with separate power packs when utilized for lighting control. Dimmers and the ballasts or drivers they control, must be provided from the same manufacturer, or tested and certified as compatible for use together.
2.5.3 Sensors for Lighting Control

UL 94, JIS C 5402-20-2 and JIS C 8201-5-1.

2.5.3.1 Occupancy Sensors

Provide occupancy sensors with coverage patterns as indicated on project plans. Provide no less quantity of sensors as shown on plans, but add additional sensors when required to fulfill coverage requirement for the specific model sensor provided. Sensor must be provided with an adaptive learning function that automatically sets sensor in optimum calibration in a set period of time after installation and a non-volatile memory that saves settings after a power outage. Provide sensors designed for ceiling, wall or wall-box installation as indicated. Operating voltage must be [105][120][210][240][277] volts.[ Operating voltage must be 24V in conjunction with a control system or separate power pack which interacts with luminaire being controlled.] Provide housing of high-impact, injection-molded thermoplastic with a multi-segmented lens for PIR and dual technology sensors. Sensor operation requires movement to activate luminaires controlled, and turns luminaires off after a set time of inactivity.[ Provide integral photocell mounted in occupancy sensor housing when indicated.]

2.5.3.1.1 Passive Infrared (PIR) Sensors

Provide ceiling or wall-mounted PIR sensors meeting the following requirements:

a. Temperature compensated, dual element sensor and a multi-element fresnel lens (Poly IR4 material).

b. Technology to optimize automatic time delay to fit occupant usage patterns.

c. No minimum load requirement for line voltage sensors and be capable of switching from zero to 800 W at [105][120] VAC, 50/60 Hz and from zero to 1200 W at [210][240][277] VAC, 50/60 Hz. Control voltage sensors must not exceed a maximum load requirement of 20 mA at 24VDC.

d. Time delay of five to 30 minutes in increments of five minutes with a walk through and test mode set by DIP switch.

e. LED indicator that remains active during occupancy.

f. Built-in light level sensor that is operational from 0.8 to 18 lux.

g. Coverage pattern tested to applicable standards.

h. Standard five year warranty.

i. No leakage current to load when in the off mode.

2.5.3.1.2 Ultrasonic Sensors

Provide ceiling-mounted ultrasonic sensors meeting the following requirements:

a. Operate at an ultrasonic frequency of [_____]kHz.
b. LED on exterior of device to indicate occupant detection.

c. Adjustable time delay period of 15 seconds to 15 minutes [_____].

d. Minimum five year warranty.

e. Provide with isolated relay for integrating control of HVAC or other automated systems.

2.5.3.1.3 Dual Technology Sensors

Provide dual technology sensors that meet the requirements for PIR sensors and ultrasonic sensors indicated above. If either the passive infrared or ultrasonic sensing registers occupancy, the luminaires must remain on.

2.5.3.1.4 High/Low-Bay Sensors

Provide occupancy sensors specifically designed for high/low-bay mounting application using passive infrared (PIR) technology, with the following characteristics:

a. Input voltage of [120][240][120/277][105][210] volts, at [50][60] hertz.

b. High-impact, injection-molded thermoplastic housing with interchangeable lenses for 360 degree open area coverage or narrow rectangular, warehouse aisle coverage.

c. Utilize zero-crossing circuitry to prevent damage from high inrush current and to promote long life operation.

d. Be designed to mount directly to or adjacent to high or low-bay luminaires.

2.5.3.1.5 Power Packs for Sensors

UL 2043 Power packs used to provide power to one or more lighting control sensors must meet the following requirements:

a. Input voltage - [105][210][120][240][120-277] VAC; output voltage - 24 VDC at 225 mA.

b. Plenum-rated, high-impact thermoplastic enclosure.

c. Utilizes zero-crossing circuitry to prevent damage from inrush current.

d. Maximum load rating of [_____] amps for electronic[_____] lighting loads.

e. RoHS compliant.

2.5.3.2 Vacancy Sensors

Provide vacancy sensors as indicated above under paragraph OCCUPANCY SENSORS, but with requirement of a manual operation to activate luminaires controlled. Provide automatic operation to turn luminaires off after a set period of inactivity.
2.5.4 Lighting Contactor

JIS C 8201-4-1. Provide an electrically/mechanically-held lighting contactor housed in a [indoor][weatherproof] rated IP enclosure conforming to JIS C 8462-1. Provide contactor with one[_____] normally-open (NO) [normally closed (NC)], single [double] pole contacts, rated 600 volts, 30 amps. Provide coil operating voltage of [24][120][277][480][105][210][240][400][_____] volts.

2.5.5 Timeswitch

JIS C 9730-2-7. [Provide electromechanical type timeswitch with a [24 hour][7 day][astronomic] dial [that changes on/off settings according to seasonal variations of sunset and sunrise]. Provide power to switch from integral synchronous motor with a maximum three watt rating. Rate contacts at 40 amps at [105][210][120][240][120-277] volts for general purpose loads. Provide contacts in a SPST[DPST][SPDT], [normally-open (NO)][normally-closed (NC)] configuration. [Provide switch with an automatic spring mechanism to maintain accurate time for up to 16 hours.] [Provide switch with function that allows automatic control to be skipped on certain selected days of the week.] [Provide switch with manual bypass[remote override] control function.]

[Provide electronic type timeswitch with a [24 hour][7 day][astronomic] programming function [that changes on/off settings according to seasonal variations of sunset and sunrise], providing a total of 56[_____] on/off set points. Provide [12 hour AM/PM][24 hour] type digital clock display format. Provide power outage back-up for switch for a minimum of [seven][_____] days. Provide switch capable of controlling a minimum of [1][2][4][_____] channels or loads. Rate contacts at [30][_____] amps at [105][210][120][240][120/277] volts for general purpose loads. Provide contacts in a SPST[DPST][SPDT], [normally-open (NO)][normally-closed (NC)] configuration. [Provide switch with function that allows automatic control to be skipped on certain selected days of the week][manual bypass or remote override control][daylight savings time adjustment][additional memory module][momentary function for output contacts][ability for photosensor input].]

House timeswitch in a surface-mounted, lockable, [indoor][weatherproof] rated IP enclosure constructed of painted steel or plastic polymer conforming to JIS C 8462-1.

2.5.6 Lighting Control Panel

Provide an electronic, programmable lighting control panel, capable of providing lighting control with input from internal programming, digital switches, time clocks, and other low-voltage control devices.

Enclose panel hardware in a surface[flush]-mounted, [indoor][weatherproof] rated IP enclosure in accordance with JIS C 0920, painted, steel enclosure, with hinged, lockable access door and ventilation openings. Internal low-voltage compartment must be separated from line-voltage compartment of enclosure with only low-voltage compartment accessible upon opening of door.[ Provide additional remote cabinets that communicate back to main control panel.]

Input voltage - [105][210][120/277] V, [50][60] Hz, with internal 24 VDC power supply.
Provide 8[16][32][_____] single-pole latching[return to close] relays rated at [20][30] amps, [120][277][105][210] volts.[ Provide provision for relays to close upon power failure that meets UL 924 and JIS C 8105-2-22.]

Relay control module must operate at 24 VDC and be rated to control a minimum of 8[16][32][_____] relays.

2.5.7 Local Area Lighting Controller

Provide controller designed for single area or room with the following requirements:

a. [105][120][210][240][277] volt input, designed for fluorescent or LED lighting loads.

b. [_____] zone, with 1[2][_____] relay[s] rated 20 amps[each].

c. Provide daylight harvesting capability with full-range dimming control.

d. Inputs for occupancy sensor, photocell, and low-voltage wall switch.

[e. Provide capability for receptacle load control.

][f. Provide full 'OFF' function with input from external time clock input.

]2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT

UL 924, JIS C 8105-2-22 and NFPA 101 compliant.

2.6.1 Exit Signs

Provide exit signs consuming a maximum of five watts total.

2.6.1.1 LED Self-Powered Exit Signs

Provide in [UV-stable, thermo-plastic][painted, die-cast aluminum][painted steel] housing with [UL damp label][UL wet label][using clear polycarbonate housing], configured for ceiling[wall][end] mounting. [Provide edge-lit type with clear acrylic, edge-lit face and aluminum trim having clear aluminum[white][chrome][brass][_____] finish.] Provide 150 mm high, 19 mm stroke red[green][_____] lettering on face of sign. Provide chevrons on either side of lettering to indicate direction. Provide single[double] face. Equip with automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free nickel-cadmium type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1 1/2 hours. LEDs must have a minimum rated life of 10 years. [Provide self-diagnostic circuitry integral to emergency LED driver.]

2.6.1.2 LED Remote-Powered Exit Signs

Provide as indicated above for self-powered type, but without battery and charger. Exit sign must contain provision for [105][210][120][240][120/277] VAC or 6-48 VDC input from remote source.

2.6.2 Emergency Lighting Unit (EBU)

Provide in [UV-stable, thermo-plastic][painted, die-cast aluminum][painted

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<th>Table 2</th>
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<td>Column 1</td>
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<tr>
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</tr>
</tbody>
</table>

FIGURES

Figure 1: Example Figure

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steel] housing with [UL damp label][UL wet label][IP rated enclosure in accordance with JIS C 0920] as indicated. Emergency lighting units must be rated for 12 volts, except units having no remote-mounted lamps and having no more than two unit-mounted light sources may be rated six volts. Equip units with brown-out sensitive circuit to activate battery when input voltage falls to 75 percent of normal. Equip with two[___] LED, automatic power failure device, test switch, and pilot light, and fully automatic high/low trickle charger in a self-contained power pack. Battery must be sealed, maintenance free [lead-calcium][nickel-cadmium][___] type, and must operate unattended for a period of not less than five years. Emergency run time must be a minimum of 1 1/2 hours. LEDs must have a minimum rated life of 10 years. [Provide self-diagnostic circuitry integral to emergency LED driver.]

2.6.3 LED Emergency Drivers

Provide LED emergency driver with automatic power failure detection, test switch and LED indicator (or combination switch/indicator) located on luminaire exterior, and fully-automatic solid-state charger, battery and inverter integral to a self-contained housing. [Provide self-diagnostic function integral to emergency driver.] Integral nickel-cadmium[lead-calcium][___] battery is required to supply a minimum of 90 minutes of emergency power at [5][7][10][___] watts, [10-50][___] VDC[compatible with LED forward voltage requirements], constant output. Driver must be RoHS compliant, rated for installation in plenum-rated spaces and damp locations, and be warranted for a minimum of five years. [Provide central lighting inverter(s) to supply a minimum of 90 minutes of emergency power.]

2.6.4 Fluorescent Emergency Ballasts

Provide each 'system' with an automatic power failure device, test switch operable from the exterior of the luminaire (or remotely), a pilot light visible from the exterior of the luminaire, and fully automatic solid-state charger, battery, and inverter integral to a self-contained housing. [Provide self-diagnostic function integral to emergency ballast.] Integral [nickel-cadmium][lead-calcium][___] battery is required to supply a minimum of 90 minutes of emergency power to one[two][___] light source[s] within luminaire at a minimum of [500][700][1200][___] lumens output[each]. Provide open-circuit protection and time-delay function to counteract 'end-of-life' circuitry in normal power ballast from interfering with emergency ballast operation. Ballast must be RoHS compliant, rated for installation in plenum-rated spaces and damp locations, and be warranted for a minimum of five years.[Provide central lighting inverter(s) to supply a minimum of 90 minutes of emergency power.]

2.6.5 Self-Diagnostic Circuitry for LED and Fluorescent Emergency Drivers/Ballasts

Provide emergency lighting unit with fully-automatic, integral self-testing/diagnostic electronic circuitry. Circuitry must provide for a one minute diagnostic test every 28 days, and a 30 minute diagnostic test every six months, minimum. Any malfunction of the unit must be indicated by LED(s) visible from the exterior of the luminaire. A manual test switch must also be provided to perform a diagnostic test at any given time.

2.6.6 Central Emergency Lighting System

Provide integrally-housed emergency system rated at [___] VA/watts, [105][____]
120[210][240][277] volts (input and output), for a minimum period of 90 minutes. Output frequency must be a pure sine wave at [50][60] hertz, with maximum 5 percent total harmonic distortion. Provide system with minimum short circuit rating required for protection against available fault current.

2.6.6.1 System Operation

During normal power operation, system charges batteries as needed and allows normal power to pass through to load. Upon loss of normal power, system automatically transfers to emergency mode without interruption of connected loads. Internal batteries provide a minimum of 90 minutes of emergency power at this time. Upon normal power being restored, system switches back to normal power mode and fully charges batteries within UL-approved time period.

2.6.6.2 Battery Charger

Solid state, monitored, three step float charging type, keeping batteries in a fully charged state. Provide circuitry to prevent deep discharge of batteries in prolonged power outage conditions.

2.6.6.3 Batteries

Provide sealed, lead calcium type, designed to operated unattended without maintenance, for a minimum of 10 years.

2.6.6.4 Enclosure

Provide system in [indoor][weatherproof][ ] rated IP enclosure in accordance with JIS C 0920 painted steel[aluminum] enclosure with exterior-mounted "push-to-test" button and LED indicator.

2.6.6.5 Accessories

Provide [____] single pole, [____] ampere output circuit breakers. [Voltmeter and ammeter for battery[load].]

2.7 LUMINAIRE SUPPORT HARDWARE

2.7.1 Wire

JIS G 3547; Galvanized, soft tempered steel, minimum 2.7 mm in diameter, or galvanized, braided steel, minimum 2 mm in diameter.

2.7.2 Wire for Humid Spaces

JIS G 4309; Annealed stainless steel, minimum 2.7 mm in diameter.

Annealed nickel-copper alloy, minimum 2.7 mm in diameter.

2.7.3 Threaded Rods

Threaded steel rods, 4.76 mm diameter, zinc or cadmium coated.

2.7.4 Straps

Galvanized steel, 25 by 4.76 mm, conforming to JIS G 3302, with a light commercial zinc coating or JIS G 3141 with an electrodeposited zinc coating.
conforming to JIS H 8610.

2.8 POWER HOOK LUMINAIRE HANGERS

JIS C 8105-1. Provide an assembly consisting of through-wired power hook housing, interlocking plug and receptacle, power cord, and luminaire support loop. Power hook housing must be cast aluminum having two 19 mm threaded hubs. Support hook must have safety screw. Fixture support loop must be cast aluminum with provisions for accepting 19 mm threaded stems. Power cord must include 410 mm of 3 conductor 1.2 mm Type SO cord or power cord per JIS C 8286. Assembly must be rated [105][120] volts or [210][277] volts, 15 amperes.

2.9 EQUIPMENT IDENTIFICATION

2.9.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.9.2 Labels

Provide labeled luminaires in accordance with JIS C 8105-1 requirements. All luminaires must be clearly marked for operation of specific light sources and ballasts, generators or drivers. Note the following light source characteristics in the format "Use Only _____":

a. Light source diameter code (T-5, T-8), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

b. Start type (programmed start, instant start) for fluorescent and compact fluorescent luminaires.

c. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. Ballasts, generators or drivers must have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.10 FACTORY APPLIED FINISH

Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of JIS C 0920 corrosion-resistance test.

2.11 RECESS- AND FLUSH-MOUNTED LUMINAIRES

Provide access to lamp and ballast from bottom of luminaire. Provide trim [and lenses] for the exposed surface of flush-mounted luminaires as indicated on project drawings and specifications.
2.12 SUSPENDED LUMINAIRES

Provide hangers capable of supporting twice the combined weight of luminaires supported by hangers. Provide with swivel hangers to ensure a plumb installation. Provide cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers must allow fixtures to swing within an angle of 0.79 rad. Brace pendants 1219 mm or longer to limit swinging. Single-unit suspended luminaires must have twin-stem hangers. Multiple-unit or continuous row luminaires must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Provide rods in minimum 4.57 mm diameter.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations must conform to IEEE C2 and JIS C 0365 and to the requirements specified herein. Install luminaires and lighting controls to meet the requirements of applicable codes and standards. To encourage consistency and uniformity, install luminaires of the same manufacture and model number when residing in the same facility or building.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature, color rendering index, and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Installation must meet requirements of applicable codes and standards. Mounting heights specified or indicated must be to the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed luminaires must be independently supported from the building structure by a minimum of four wires, straps or rods per luminaire and located near each corner of the luminaire. Ceiling grid clips are not allowed as an alternative to independently supported luminaires. Round luminaires or luminaires smaller in size than the ceiling grid must be independently supported from the building structure by a minimum of four wires, straps or rods per luminaire, spaced approximately equidistant around. Do not support luminaires by acoustical tile ceiling panels. Where luminaires of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support each independently and provide at least two 19 mm metal channels spanning, and secured to, the ceiling tees for centering and aligning the luminaire. Provide wires, straps, or rods for luminaire support in this section. Luminaires installed in suspended ceilings must also comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.
3.1.3  Suspended Luminaires

Provide suspended luminaires with 0.79 rad swivel hangers so that they hang plumb and level. Locate so that there are no obstructions within the 0.79 rad range in all directions. The stem, canopy and luminaire must be capable of 0.79 rad swing. Pendants, rods, or chains 1.2 meters or longer excluding luminaire must be braced to prevent swaying using three cables at 2.09 rad separation. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints. Support steel luminaires to prevent "oil-canning" effects. Luminaire finishes must be free of scratches, nicks, dents, and warps, and must match the color and gloss specified. Match supporting pendants with supported luminaire. Aircraft cable must be stainless steel. Canopies must be finished to match the ceiling and must be low profile unless otherwise shown. Maximum distance between suspension points must be 3.1 meters or as recommended by the manufacturer, whichever is less.

3.1.4  Ballasts, Generators and Power Supplies

Typically, provide ballasts, generators, and power supplies (drivers) integral to luminaire as constructed by the manufacturer.

3.1.5  Exit Signs and Emergency Lighting Units

Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

3.1.5.1  Exit Signs

Connect exit signs on separate circuits and serve from [an emergency panel][a separate circuit breaker][a fused disconnect switch]. Provide only one source of control, which would be [the circuit breaker in the emergency panel][the separate circuit breaker][the fused disconnect switch]. Paint source of control red and provide lockout capability.

3.1.5.2  Emergency Lighting from Central Emergency System

Connect emergency lighting from a central emergency system as indicated on the project drawings.

3.1.6  Photocell Switch Aiming

Aim switch according to manufacturer's recommendations.

3.1.7  Occupancy/Vacancy Sensors

Provide testing of sensor coverage in all spaces where sensors are placed. This should be done only after all furnishings (carpet, furniture, workstations, etc.) have been installed. Provide quantity of sensor units indicated as a minimum. Provide additional units to give full coverage over controlled area. Full coverage must provide hand and arm motion detection for office and administration type areas and walking motion for industrial areas, warehouses, storage rooms and hallways. Locate the sensor(s) as indicated and in accordance with the manufacturer's recommendations to maximize energy savings and to avoid nuisance activation and deactivation due to sudden temperature or airflow changes and usage.
3.1.8 Daylight or Ambient Light Level Sensor

Locate sensor as indicated and in accordance with the manufacturer's recommendations. Adjust sensor for 300 lux or for the indicated light level measured at the work plane for that particular area.

3.2 FIELD APPLIED PAINTING

Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as specified in Section 09 90 00 PAINTS AND COATINGS.

-- End of Section --
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DIVISION 26 - ELECTRICAL

SECTION 26 56 00

EXTERIOR LIGHTING

05/13

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-- End of Section Table of Contents --
PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS) or Japan Luminaires Association (JIL) for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2  (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5373  (2016) Precast Prestressed Concrete Products


JIS C 5381-11  (2014) Low-voltage surge protective devices -- Part 11: Surge protective devices connected to low-voltage power systems -- Requirements and test methods

JIS C 61000-3-2  (2019) Electromagnetic compatibility (EMC) -- Part 3-2: Limits -- Limits for harmonic current emissions


JIS C 8105-2-3  (2011) Lighting-Part 2-3: Road and Street Lighting Fixtures Safety requirements

JIS C 8131  (2013) Luminaires for Road Lighting


1.2 RELATED REQUIREMENTS

Materials not considered to be luminaires or lighting equipment are specified in Section(s) [33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION] [33 71 01.00 40 OVERHEAD TRANSMISSION AND DISTRIBUTION] [33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION]. Luminaires and accessories installed in interior of buildings are specified in Section [26 51 00 INTERIOR LIGHTING] [26 51 00.00 40 INTERIOR LIGHTING].

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings shall be as defined in JIS Z 8113.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Photometric Plan; G[, [____]]

LED Luminaire Warranty;

SD-02 Shop Drawings

Luminaire Drawings

Poles

SD-03 Product Data

[  [LED, ]Luminaires; G[, [____]]
 ]

Luminaire Light Sources; G[, [____]]

Luminaire[ Power Supply Units (Drivers)]; G[, [____]]

Lighting Contactor; G[, [____]]

Time Switch; G[, [____]]

Lighting Control Relay Panel; G[, [____]]

Motion Sensor; G[, [____]]

Photocell; G[, [____]]

Concrete Poles; G[, [____]]

Aluminum Poles; G[, [____]]

Steel Poles; G[, [____]]

Fiberglass Poles; G[, [____]]

Obstruction Marker Luminaires; G[, [____]]

SD-06 Test Reports

Operating Test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Operational Service
Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

1.5.1.2 Poles

Include dimensions, wind load determined in accordance with JIS C 8105-2-3, pole deflection, pole class, and other applicable information. For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.

1.5.2 Photometric Plan

For LED luminaires, include computer-generated photometric analysis of the "designed to" values for the "end of useful life" of the luminaire installation using a light loss factor of 0.7. For LED and all other types of luminaires, the submittal shall include the following:

Horizontal illuminance measurements at finished grade, taken at a maximum of every 3050 mm.

Vertical illuminance measurements at 1500 mm above finished grade.

Minimum and maximum lux levels.

Average maintained lux level.

Maximum to minimum ratio for horizontal illuminance only.

1.5.3 Design Data for Luminaires

a. Provide distribution data according to IES classification type as defined in JIS Z 9110.

b. Shielding as defined by JIS Z 9111 or glare rating for the installed position as defined by JIS Z 9110.

c. Provide wind loading calculations for luminaires mounted on poles. Weight and effective projected area (EPA) of luminaires and mounting brackets shall not exceed maximum rating of pole as installed in particular wind zone area.

1.5.4 LED Luminaire - Test Report

Submit test report on manufacturer's standard production model luminaire.
Submittal shall include all photometric and electrical measurements, as well as all other pertinent data per JIS C 8152-2.

1.5.5 LED Light Source - Test Report

Submit report on manufacturer's standard production LED package, array, or module. Submittal shall include:

a. Testing agency, report number, date, type of equipment, and LED light source being tested.

b. All data required by JIS C 8152-3.

1.5.5.1 Test Laboratories

Test laboratories for the JIS C 8152-2 and JIS C 8152-3 test reports shall be:

A manufacturer's in-house lab that meets the following criteria:

1. Manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires and the manufacturer's lab has been successfully certifying these fixtures for a minimum of 15 years.

2. Annual equipment calibration including photometer calibration in accordance with applicable standards.

[1.5.6 Tests for Fiberglass Poles]

a. Ultraviolet resistance tests: Perform using a UV-B light source having a 313 nanometer wavelength, operated at 54 degrees C, cycling the light source on for 4 hours and off for 4 hours for a total test period of 1500 hours minimum with the following results:

<table>
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<tr>
<td>Crazing:</td>
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</tr>
<tr>
<td>Checking:</td>
<td>None</td>
</tr>
<tr>
<td>Chalking:</td>
<td>None</td>
</tr>
<tr>
<td>Color:</td>
<td>May dull slightly</td>
</tr>
</tbody>
</table>

b. Flexural strength and deflection test: Test loading shall be as a cantilever beam with pole butt as fixed end and a force simulating wind load at the free end.

[1.5.7 Regulatory Requirements]

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent
requirements are specified or indicated.

1.5.8 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.8.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if the manufacturer has been regularly engaged in the design and production of high intensity discharge roadway and area luminaires for a minimum of 15 years. Products shall have been in satisfactory commercial or industrial use for 15 years prior to bid opening. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 15-year period.

1.5.8.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

[1.6 DELIVERY, STORAGE, AND HANDLING OF POLES]

[1.6.1 Concrete Poles

Do not store poles on ground. Support poles so they are at least 305 mm above ground level and growing vegetation.

][1.6.2 [Fiberglass] [Aluminum] [Steel] Poles

Do not store poles on ground. Support poles so they are at least 305 mm above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

][1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

[1.7.1 LED Luminaire Warranty

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

a. Provide a written five year on-site replacement warranty for material,
fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

1. Finish warranty shall include warranty against failure and against substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

2. Material warranty shall include:
   
   (a) All power supply units (drivers).

   (b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

   b. Warranty period must begin on date of beneficial occupancy. Contractor shall provide the Contracting Officer signed warranty certificates prior to final payment.

]1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for [maintenance agreement] [take-back program]. Collect information from the manufacturer about [maintenance agreement] [green lease] options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not deposit materials in landfills or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be luminaires, equipment or accessories are specified in [Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION,] [Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION,] [and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.] Luminaires and associated equipment and accessories for interior applications are specified in Section 26 51 00 INTERIOR LIGHTING.

2.2 [LED,] LUMINAIRES

JIS C 61000-3-2, JIS C 8154 and JIS C 8155. Provide luminaires as indicated in luminaire schedule and XL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. All luminaires of the same type shall be provided by the same manufacturer.

2.2.1 General Requirements

   a.[ LED luminaire housings shall be die cast or extruded aluminum.][ Housings for luminaires other than LED shall be die cast, extruded, or fabricated aluminum. Fabricated aluminum housings shall have all seams and corners internally welded to resist weathering, moisture and dust.]

   [ b. LED luminaires shall be rated for operation within an ambient temperature range of minus 30 degrees C to[ 40 degrees C][ 50 degrees C ].]
c. Luminaires shall be listed for wet locations per JIS C 8105-1. Optical compartment for LED luminaires shall be sealed and rated a minimum of IP65.

d. LED luminaires shall produce a minimum efficacy as shown in the following table, tested per JIS C 8152-2. Theoretical models of initial raw LED lumens per watt are not acceptable.

<table>
<thead>
<tr>
<th>Application</th>
<th>Luminaire Efficacy in Lumens per Watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior Pole/Arm-Mounted Area and Roadway Luminaires</td>
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</tr>
<tr>
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</tr>
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<td>Exterior Wall-Mounted Area Luminaires</td>
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</tr>
<tr>
<td>Bollards</td>
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</tr>
<tr>
<td>Parking Garage Luminaires</td>
<td>70</td>
</tr>
</tbody>
</table>

e. Luminaires shall have lighting distribution and field angle classifications as indicated in luminaire schedule on project plans per JIS Z 9110.

f. Housing finish shall be baked-on enamel, anodized, or baked-on powder coat paint. Finish shall be capable of surviving JIS Z 2371 salt fog environment testing for 2500 hours minimum without blistering or peeling.

g. Luminaires shall not exceed the following JIS Z 9110 Glare ratings:
   1. Maximum Glare (G) rating shall be determined by lighting zone in which luminaire is placed.

h. Luminaires shall be fully assembled and electrically tested prior to shipment from factory.

i. The finish color shall be as indicated in the luminaire schedule or detail on the project plans.

j. Luminaire arm bolts shall be 304 stainless steel or zinc-plated steel.

k. Luminaire lenses shall be constructed of [clear][frosted] tempered glass or UV-resistant acrylic. [Provide polycarbonate vandal-resistant lenses as indicated.]

l. The wiring compartment on pole-mounted, street and area luminaires must be accessible without the use of hand tools to manipulate small screws, bolts, or hardware.

m. Incorporate modular electrical connections, and construct luminaires to allow replacement of all or any part of the optics, heat sinks, power supply units, ballasts, surge suppressors and other electrical components using only a simple tool, such as a manual or cordless
electric screwdriver.

n. Luminaires shall have a nameplate bearing the manufacturer's name, address, model number, date of manufacture, and serial number securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

[ o. Roadway and area luminaires shall have an integral tilt adjustment of plus or minus 5 degrees to allow the unit to be leveled in accordance with JIS C 8105-2-3.

] p. Luminaire must pass vibration testing in accordance with JIS C 8105-2-3 and JIS C 8131.

q. All factory electrical connections shall be made using crimp, locking, or latching style connectors. Twist-style wire nuts are not acceptable.

2.2.2 Luminaire Light Sources

[2.2.2.1 LED Light Sources

a. Correlated Color Temperature (CCT) shall be in accordance with JIS C 8155:

[ Nominal CCT: 4000 degrees K: 3985 plus or minus 275 degrees K

] b. Color Rendering Index (CRI) shall be:

Greater than or equal to [70] [_____] for 4000 degrees K light sources.

c. Color Consistency:

]2.2.3 Luminaire[ Power Supply Units (Drivers)]

[2.2.3.1 LED Power Supply Units (Drivers)

JIS C 8153. LED Power Supply Units (Drivers) shall meet the following requirements:

a. Minimum efficiency shall be 85 percent.

b. Shall be rated to operate between ambient temperatures of minus 30 degrees C and 40 degrees C[ 50 degrees C].

c. Shall be designed to operate on the voltage system to which they are connected, typically ranging from 120 V to 480 V or 100V to 430V nominal.

d. Operating frequency shall be: 50 or 60 Hz.

e. Power Factor (PF) shall be greater than or equal to 0.90.

f. Total Harmonic Distortion (THD) current shall be less than or equal to 20 percent.

g. Shall be RoHS-compliant.
h. Shall be mounted integral to luminaire. Remote mounting of power supply is not allowed.

i. Shall be dimmable, and compatible with a standard dimming control circuit of 0 - 10V or other approved dimming system.

j. Shall be equipped with over-temperature protection circuit that turns light source off until normal operating temperature is achieved.

2.2.4 LED Luminaire Surge Protection

Provide surge protection integral to luminaire as defined by JIS C 5381-11

2.3 OBSTRUCTION MARKER LUMINAIRES

Provide obstruction marker luminaires for facilities as required by the FAA and in accordance with Section 26 56 20 AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS.

2.4 EXTERIOR LUMINAIRE CONTROLS

Provide a control system interface within each luminaire that is compatible with the energy management or control system used by the utility department in charge of the project area for control of site lighting.

2.4.1 Photocell

JIS C 8369. Photocells shall be hermetically sealed, [cadmium sulfide] [silicon diode] light sensor type, rated at [_____] watts, [_____] volts, 50/60 Hz with single-pole, [single] [double]-throw contacts. Photocell shall be designed to fail to the ON position. Housing shall be constructed of [polycarbonate] [die cast aluminum] [UV stabilized polypropylene], rated to operate within a temperature range of minus 40 to 70 degrees C. Photocell shall have a 13 mm threaded base for mounting to a junction box or conduit. Provide [fixed] [swivel] base type housing. Photocell shall be twist-lock receptacle type=. Provide with solid brass prongs and voltage markings and color coding on exterior of housing. Photocell shall turn on at 10-30 lux and turn off at 30 to 150 lux. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide photocell with metal oxide varistor (MOV) type surge protection. Photocell to be designed for 20-year service to match life expectancy of long-life LED fixtures and exceeds 15,000 operations at full load. Provide photocell with zero-cross technology to withstand severe in-rush current and extend relay life.

2.4.2 Timeswitch

Timeswitch shall be electromechanical type with a [24 hour] [7 day] [astronomic] dial[ that changes on/off settings according to seasonal variations of sunset and sunrise]. Switch shall be powered by an enclosed synchronous motor with a maximum 3 watt operating rating. Timeswitch contacts shall be rated for [40] [_____] amps at 120-277 or 100-230 VAC resistive load in a [SPST] [DPST] [SPDT] [DPST] [ normally open (NO)] [ normally closed (NC)] configuration. Switch shall have an automatic spring mechanism to maintain accurate time for up to 16 hours during a power failure. Provide switch with function that allows automatic control to be skipped on certain selected days of the week. Provide switch with manual
bypass or remote override control.

[Timeswitch shall be an electronic type with a [24 hour][7 day] [astronomic] programming function [that changes on/off settings according to seasonal variations of sunset and sunrise], providing a total of [56][_____] on/off set points. Digital clock display format shall be[AM/PM 12 hour][24 hour] type. Provide power outage backup for switch utilizing a[capacitor][alkaline batteries][lithium battery] which provides coverage for a minimum of [7 days][3 years][8 years]. Timeswitch shall provide control to [1][2][4][_____] channels or loads. Contacts shall be rated for [30][_____] amps at 120-277 or 100-230 VAC resistive load in a [SPST][DPST][SPDT][DPST] [normally open (NO)][normally closed (NC)] configuration. [Provide switch with [function that allows automatic control to be skipped on certain selected days of the week][manual bypass or remote override control][daylight savings time automatic adjustment][EEPROM memory module][momentary function for output contacts][ability for photosensor input]].

Timeswitch shall be housed in a surface-mounted, lockable [indoor][weatherproof][ ] IP rated enclosure constructed of painted steel or plastic polymer conforming to JIS C 8462-1.

][2.4.3 Lighting Contactor

JIS C 8201-4-3. Provide a [mechanically][electrically]-held lighting contactor [housed in a [indoor][weatherproof][ ] IP rated enclosure conforming to JIS C 8462-1]. Contactor shall have [2][4][6][_____] poles, configured as [normally open (NO)][normally closed (NC)]. Contacts shall be rated [600][_____] volts, [30][_____] amperes for a resistive load. Coil operating voltage shall be [24][105][120][210][240][277][_____] volts. Contactor shall have silver cadmium oxide double-break contacts [and coil clearing contacts for mechanically held contactors] and shall require no arcing contacts. [Provide contactor with hand-off-automatic [on-off] selector switch.][Provide contactor as specified above along with [disconnect switch][circuit breaker] in integral [indoor][weatherproof][ ] IP rated enclosure with flange-mounted handle to satisfy requirement for a "combination lighting contactor" when specified.]

][2.4.4 Lighting Control Relay Panel

Panel shall consist of a single [indoor][weatherproof][ ] IP rated [flush][surface]-mounted enclosure with two separate interior sections; one for Class 1 (branch circuit) and one for Class 2 (low voltage) wiring. Provide panel with [8][16][32][_____] relays. Panel shall be designed as [a stand alone][an automated control system interface] type. The Class 1 section shall contain the load side of all relays and the incoming branch circuit wiring. The Class 2 section shall contain the control power transformer (24 volt output), relays, relay control modules, and control wiring[, and native BACnet[LONworks] field-programmable application controller for panels connected to the facility automated control system]. Panel enclosure shall be constructed of [16][14] gauge cold-rolled steel with baked-on enamel finish.

Relays shall be [1][2]-pole, rated at 20 amperes [210][300][420][440][480] VAC with rated life of 120,000 mechanical operations minimum.

Relay control module shall be 24 volt, electronic type and control up to 16 separate relays (16 channel) or programmed groups of relays. Provide with
inputs for signals from devices such as photocells, timeclocks, and motion sensors.  [Relay control module with integral timeclock function shall be 24 volt, electronic type with LCD display and control up to 8 separate relays (8 channel)].

][2.4.5 Motion Sensor

JIS C 8201-5-2.  Provide [passive infrared][microwave][dual technology passive infrared/microwave] type sensors with [270][_____] degree coverage, time delay that can be adjusted from 15 seconds to 15 minutes, and "fail to ON position" default state.  Sensors shall be located to achieve coverage of areas as indicated on project plans.  Coverage patterns shall be derated as recommended by manufacturer based on mounting height of sensor and any obstructions such as trees.  Do not use gross rated coverage in manufacturer's product literature.  Sensors installed integral to the luminaire must be provided by the luminaire manufacturer.  Sensors shall have an integral light level sensor that does not allow luminaires to operate during daylight hours and shall be designed to operate on a voltage of [105 VAC][210 VAC][120/277 VAC][24 VDC].  [Provide sensors to operate in conjunction with bi-level controllers that lower LED luminaires to a 50 percent output.]  Sensor shall be [equipped with a threaded base for mounting to a weatherproof junction box][mounted directly to luminaire].

][2.5 POLES

Provide poles designed for wind loading of [161][_____] km/hr determined in accordance with JIS C 8105-2-3 while supporting luminaires and all other appurtenances indicated.  The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole.  Poles shall be [embedded][anchor]-base type designed for use with [underground][overhead] supply conductors.[ Poles[, other than wood poles,] shall have oval-shaped handhole having a minimum clear opening of 65 by 130 mm.  Handhole cover shall be secured by stainless steel captive screws.][ Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole.]  Scratched, stained, chipped, or dented poles shall not be installed.

[2.5.1 Concrete Poles

Provide concrete poles conforming to JIS A 5373.  Cross-sectional shape shall be [round][or][multi-sided].  Provide poles designed for wind loading of [100][____] meters per hour determined in accordance with JIS C 8105-2-3 while supporting luminaires and all other appurtenances indicated.  The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole.

2.5.1.1 Steel Reinforcing

Prestressed concrete pole shafts shall be reinforced with steel prestressing members.  Design shall provide internal longitudinal loading by either pretensioning or post tensioning of longitudinal reinforcing members.

2.5.1.2 Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned between 60 to 70 percent of its ultimate strength.  The amount of reinforcement shall be such that when reinforcement is tensioned
to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

2.5.1.3 Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, reinforcing shall be protected with a vaporproof noncorrosive sleeve over the length without the 13 mm concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a nonmigrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

2.5.1.4 Strength Requirement

As an exception to the requirements of JIS A 5373, poles shall be naturally cured to achieve a 28-day compressive strength of 48.23 MPa. Poles shall not be subjected to severe temperature changes during the curing period.

2.5.1.5 Shaft Preparation

Completed prestressed concrete pole shaft shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, and shall be clean, smooth, and free of surface voids and internal honeycombing. Poles shall not be installed for at least 15 days after manufacture.

2.5.2 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to JIS C 8105-2-3 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3.5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 4.8 mm wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast aluminum alloy and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast aluminum alloy. Hardware, except anchor bolts, shall be either anodized aluminum alloy or stainless steel. Aluminum poles and brackets for walkway lighting shall have a uniform satin dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

2.5.3 Steel Poles

Provide steel poles having minimum 11-gage steel with minimum yield/strength of 331 MPa and hot-dipped galvanized in accordance with JIS H 8641 iron-oxide primed factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Pole shall be direct set or anchor bolt mounted type. Poles shall have tapered tubular members, either round in cross section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 900 to 1270 mm above grade and shall include manufacturer, year of manufacture, top and
bottom diameters, and length.

Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 248 MPa.]

][2.5.4 Fiberglass Poles

Designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Resin color shall be [dark bronze][as indicated][____], and pigment shall provide uniform coloration throughout entire wall thickness. Finish surface shall be pigmented polyurethane having a minimum dry film thickness of 0.038 mm. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

][2.6 BRACKETS AND SUPPORTS

JIS C 8105-2-3, as applicable. Pole brackets shall be not less than 31.75 mm [galvanized steel pipe][aluminum] secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 7320 mm above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

][2.7 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 344.5 MPa; the top 305 mm of the rod shall be galvanized. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

]2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

Provide labeled luminaires in accordance with JIS C 8105-1 requirements. Luminaires shall be clearly marked for operation of specific light sources and ballasts according to proper light source type. The following light source characteristics shall be noted in the format "Use Only _____":

a. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place.

2.9 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which
shall, as a minimum, meet the requirements of JIS C 0920 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, JIS C 0365 and to the requirements specified herein.

3.1.1 Concrete Poles

Install concrete poles per JIS A 5373. Poles shall be [embedded] anchor-base type designed for use with [underground] [overhead] supply conductors. Install according to pole manufacturer's instructions.

3.1.2 Fiberglass Poles

Install fiberglass poles designed specifically for supporting luminaires and having factory-formed cable entrance and handhole. Install according to pole manufacturer's instructions and applicable standards.

3.1.3 [Aluminum][Steel] Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Thoroughly compact backfill with compaction arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. After installation, paint exposed surfaces of steel poles with two finish coats of exterior oil paint of a color as indicated [aluminum paint]. Install according to pole manufacturer's instructions. Alterations to poles after fabrication will void manufacturer's warranty and shall not be allowed.

3.1.4 Pole Setting

[Depth shall be as indicated. ] [Poles in straight runs shall be in a straight line. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 150 mm maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.]

3.1.5 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. [Mount switch on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm. ][Set adjustable window slide for [_____] lux photocell turn-on.]

3.1.6 GROUNDING

Ground noncurrent-carrying parts of equipment including [metal poles,] luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Where copper
grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.7 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test after 100 hours of burn-in time to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --
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DIVISION 27 - COMMUNICATIONS

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

08/11

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS), Japan Architectural Standard Specification (JASS), or Japan Wire Industry Association Standard (JCS) standards for non-Japanese standards, as approved by the Contracting Officer's representative.

JAPAN WIRE INDUSTRY ASSOCIATION STANDARD (JCS)

JCS 5507 (2010) LAN Twisted Pair Cable

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS C 3665-1-1 (2007) Tests on electric and optical fibre cables under fire conditions -- Part 1-1: Test for vertical flame propagation for a single insulated wire or cable -- Apparatus

JIS C 5964-4 (2014) Fiber optic connector interfaces -- Part 4: Type SC connector family (F04 Type)

JIS C 5964-4-100 (2018) Fiber optic connector interfaces -- Part 4-100: Type SC connector family -- Simplified receptacle SC-PC connector interfaces (F16 type)

JIS C 5964-18 (2014) Fiber optic connector interfaces -- Part 18: Type MT-RJ connector family (F19 type)

JIS C 5964-20 (2015) Fiber optic connector interfaces -- Part 20: Type LC connector family


JIS C 6012-3-100 (2015) Mechanical structures for electronic equipment -- Dimensions of mechanical structures of the 482.6 mm (19 in) series -- Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets
1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP), apply to this section with additions and modifications specified herein.
DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in JIS X 5150, JCS 5507, JIS C 6820, JIS C 6850, and herein.

1.3.1 Campus Distributor (CD)
A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)
A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)
A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)
An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)
An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.3.6 Equipment Room (ER) (Telecommunications)
An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable
Cabling that is not run in a raceway as defined by applicable codes and standards. This refers to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Open Office
A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway
A physical infrastructure utilized for the placement and routing of telecommunications cable.
1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, service entrance facilities, work area pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for splicing, terminating, and interconnecting cabling necessary to transport telephone and data (including LAN) between equipment items in a building. The horizontal system shall be wired in a star topology from the telecommunications work area to the floor distributor or campus distributor at the center or hub of the star. The backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star.[ The interbuilding backbone system provides connectivity between the campus distributors and is specified in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).] Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.[ The telecommunications contractor must coordinate with the NMCI/COSC/NGEN contractor concerning access to and configuration of telecommunications spaces. The telecommunications contractor may be required to coordinate work effort within the telecommunications spaces with the NMCI/COSC/NGEN contractor.]

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G[, [_____]]

Telecommunications Space Drawings; G[, [_____]]

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G[, [_____]]

Patch panels; G[, [_____]]

Telecommunications outlet/connector assemblies; G[, [_____]]

Equipment support frame; G[, [_____]]

[Connector blocks; G[, [_____]]]

SD-06 Test Reports
Telecommunications cabling testing;
SD-10 Operation and Maintenance Data
Telecommunications cabling and pathway system Data Package 5;
SD-11 Closeout Submittals
Record Documentation;

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 279 by 432 mm in size using a minimum scale of one mm per 100 mm[, except as specified otherwise]. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Drawings

Provide[ registered communications distribution designer (RCDD) approved,] drawings in accordance with applicable codes and standards. The identifier for each termination and cable shall appear on the drawings. Drawings shall depict final telecommunications installed wiring system infrastructure. The drawings should provide details required to prove that the distribution system shall properly support connectivity from the EF telecommunications and ER telecommunications, CD's[, BD's], and FD's to the telecommunications work area outlets.[ Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, CD's, BD's, FD's, and the EF and ER for telecommunications keyed to floor plans by room number. Mount the laminated schematic in the EF telecommunications space as directed by the Contracting Officer.] The following drawings shall be provided as a minimum:

a. T1 - Layout of complete building per floor - Building Area/Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways. Layout of complete building per floor. The drawing indicates location of building areas, serving zones, vertical backbone diagrams, telecommunications rooms, access points, pathways, grounding system, and other systems that need to be viewed from the complete building perspective.

b. T2 - Serving Zones/Building Area Drawings - Drop Locations and Cable Identification (ID’S). Shows a building area or serving zone. These drawings show drop locations, telecommunications rooms, access points and detail call outs for common equipment rooms and other congested areas.

c. T4 - Typical Detail Drawings - Faceplate Labeling, Firestopping,
Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate labeling, faceplate types, faceplate population installation procedures, detail racking, and raceways.

1.6.1.2 Telecommunications Space Drawings

Provide T3 drawings that include telecommunications rooms plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and [cabinet], [rack], [backboard] and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of [3] years experience in the installation of the specified copper
and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using [optical fiber and] copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of [3] [_____] years experience in the manufacturing, assembly, and factory testing of components which comply with JIS X 5150, JCS 5507 and JIS C 6820 and JIS C 6850.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, [60] [_____] days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and
advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than [2] [_____] months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs
TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts and cover plate assignments, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided[ in hard copy format][ on electronic media using Windows based computer cable management software.][ A licensed copy of the cable management software including documentation, shall be provided.] Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided. The cable records shall [include only the required data fields][include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility ]. Include manufacture date of cable with submittal.

b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type, and outlets shall be provided. Documentation shall include the required data fields[ as a minimum][ only].

PART 2 PRODUCTS

2.1 COMPONENTS

Components shall be UL or third party certified. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard. Provide a complete system of telecommunications cabling and pathway components using star topology. Provide support structures and pathways, complete with outlets, cables, connecting hardware and telecommunications cabinets/racks. Cabling and interconnecting hardware and components for telecommunications systems shall be listed or third party independent testing laboratory certified, and shall comply with applicable codes and standards and conform to the requirements specified herein.

2.2 TELECOMMUNICATIONS PATHWAY

Provide telecommunications pathways in accordance with JIS X 5150 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3 TELECOMMUNICATIONS CABLELING

Cabling shall be listed for the application and shall comply with JIS X 5150, JCS 5507, JIS C 6820 and JIS C 6850. Provide a labeling system for cabling
as required. Ship cable on reels or in boxes bearing manufacture date for unshielded twisted pair (UTP) in accordance with JCS 5507 and optical fiber cables in accordance with JIS C 6870-2 for all cable used on this project. Cabling manufactured more than 12 months prior to date of installation shall not be used.

2.3.1 Backbone Cabling

2.3.1.1 Backbone Copper

Copper backbone cable shall be solid conductor, 0.2 sqmm, 100 ohm, [100] [____]-pair, Category 3, UTP, in accordance with JCS 5507, JIS X 5150, JCS 5507 and JCS 5000 series, formed into [25][10] pair binder groups covered with a[ gray][ ____] thermoplastic jacket[ and overall metallic shield]. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular length marking intervals in accordance with JCS 5507. Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling as required. Substitution of a higher rated cable shall be permitted upon approval prior to installation.

2.3.1.2 Backbone Optical Fiber

Provide in accordance with JIS C 6870-2, JIS C 6820, JIS C 6850, UL 1666 and JIS C 3665-1-1. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 1 meter.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode(OS1), tight buffered fiber optic cable.

[Provide tight buffered fiber optic multimode, [50/125-um diameter laser optimized(OM3)],[50/125-um diameter(OM2)],[62.5/125-um diameter(OM1)] cable as indicated.]

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable as required per application. Substitution of a higher rated cable shall be permitted. The cable cordage jacket, fiber, unit, and group color shall be in accordance with JIS X 5150.

Provide plenum (OFNP) riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable as required per application. Substitution of a higher rated cable shall be permitted. The cable cordage jacket, fiber, unit, and group color shall be in accordance with JIS X 5150.

2.3.2 Horizontal Cabling

Provide horizontal cable and performance characteristics in accordance with JIS X 5150.

2.3.2.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with JCS 5507, and JIS X 5150. Provide four each individually twisted pair, minimum size 0.2 sqmm conductors, Category 6, with a[ blue][ ____] thermoplastic jacket. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating
Provide plenum (CMP), riser (CMR), or general purpose (CM or CMG) communications rated cabling as required per application. Substitution of a higher rated cable shall be permitted. Cables installed in conduit within and under slabs shall be listed and labeled for wet locations. [Provide residential Category 6 cabling as required.]

2.3.2.2 Horizontal Optical Fiber

Provide optical fiber horizontal cable in accordance with JIS C 6870-2 and JIS C 6820 and JIS C 6850. Cable shall be tight buffered, [multimode, 50/125-um diameter laser optimized, OM3][, ][multimode, 50/125-um diameter, OM2][multimode, 62.5/125-um diameter, OM1][single-mode, 8/125-um diameter, OS1]. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 1 meter.

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable as required per application. Substitution of a higher rated cable shall be permitted. Cables installed in conduit within and under slabs be listed and labeled for wet locations. The cable jacket shall be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with JIS X 5150.

2.3.3 Work Area Cabling

2.3.3.1 Work Area Copper

Provide work area copper cable in accordance with JCS 5507, with a[ blue,][ ___] thermoplastic jacket.

2.3.3.2 Work Area Optical Fiber

Provide optical work area cable in accordance with JIS C 6820 and JIS C 6850.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility[ and telecommunication equipment room[s]] to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with [base][facility] standards.

2.4.1 Backboards

Provide void-free, interior grade A-C plywood 19 mm thick[1200 by 2400 mm] [as indicated]. Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible.[ Paint applied over fire retardant backboard shall be UL 723 and JIS C 60364-4-42 fire retardant paint. Provide label including paint manufacturer, date painted, UL listing and name of Installer. When painted, paint label and fire stamp shall be clearly visible.] Backboards shall be provided on a minimum of two adjacent walls in the telecommunication spaces.

2.4.2 Equipment Support Frame

Provide in accordance with JIS C 6011-1 and JIS C 6012-3-100.

[ a. Bracket, wall mounted, 8 gauge aluminum. Provide hinged bracket
2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 6 systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.4.4 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on [482.6][584] mm equipment [racks][cabinets][ and ][ telecommunications backboards]. Cable guides of ring or bracket type devices mounted on [rack][cabinet] panels[backboard] for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws,[ and ][ or ]nuts and lockwashers.

2.4.5 Patch Panels

Provide ports for the number of horizontal and backbone cables terminated on the panel plus [25][_____] percent spare. Provide pre-connectorized [optical fiber][ and ][copper] patch cords for patch panels. Provide patch cords, as complete assemblies, with matching connectors as specified. Provide fiber optic patch cables with crossover orientation in accordance with JIS C 6820 and JIS C 6850. Patch cords shall meet minimum performance requirements specified in JIS X 5150, JCS 5507 [ and JIS C 6820 and JIS C 6850] for cables, cable length and hardware specified.

2.4.5.1 Modular to 110 Block Patch Panel

Provide in accordance with JIS X 5150 and JCS 5507. Panels shall be third
party verified[ and shall comply with EIA/TIA Category 6 requirements]. Panel shall be constructed of 2.2 mm minimum aluminum and shall be [cabinet][rack][wall] mounted and compatible with JIS C 6012-3-100 [482.6 mm][584 mm] equipment [cabinet][rack]. Panel shall provide [48][_____] non-keyed, 8-pin modular ports, wired to [T568A][T568B]. Patch panels shall terminate the building cabling on Type 110 IDCs and shall utilize a printed circuit board interface. The rear of each panel shall have incoming cable strain-relief and routing guides. Panels shall have each port factory numbered and be equipped with laminated plastic nameplates above each port.

2.4.5.2 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of [16][18] gauge steel[ or][11 gauge aluminum] minimum and shall be [cabinet][rack][wall] mounted and compatible with a JIS C 6012-3-100 [482.6 mm][584 mm] equipment rack. Each panel shall provide [12][_____] [multimode][single-mode] adapters as [duplex LC in accordance with JIS C 5964-20 with zirconia ceramic alignment sleeves],[duplex SC in accordance with JIS C 5964-4 and JIS C 5964-4-100 with zirconia ceramic][MT-RJ in accordance with JIS C 5964-18 with thermoplastic][ST in accordance with metallic] alignment sleeves. Provide dust cover for unused adapters. The rear of each panel shall have a cable management tray a minimum of 203 mm deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

2.4.6 Optical Fiber Distribution Panel

[Cabinet][Rack][Wall] mounted optical fiber distribution panel (OFDP) shall be constructed in accordance with JIS C 6012-3-100 utilizing [16][18] gauge steel[ or][11 gauge aluminum] minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide [12][_____] multimode[ and][12][_____] single-mode] pigtails and adapters. Provide adapters as [duplex LC with zirconia ceramic][MT-RJ with thermoplastic][ST with metallic] alignment sleeves. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with JIS X 5150 and JCS 5507. UTP outlet/connectors shall be JIS X 5150 listed, non-keyed, 8-pin modular, constructed of high impact rated thermoplastic housing and shall be third party verified[ and shall comply with JCS 5507 Category 6 requirements.]

Outlet/connectors provided for UTP cabling shall meet or exceed the requirements for the cable provided. Outlet/connectors shall be terminated using a Type 110 IDC PC board connector, color-coded for both T568A and T568B wiring. Each outlet/connector shall be wired [T568A][ or ][T568B][as indicated]. UTP outlet/connectors shall comply with JCS 5507 for [200][_____] mating cycles.[ UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.]
2.5.2 Optical Fiber Adapters (Couplers)

Provide optical fiber adapters suitable for [duplex LC in accordance with JIS C 5964-20 with zirconia ceramic alignment sleeves,][duplex SC in accordance with JIS C 5964-4 and JIS C 5964-4-100 with zirconia ceramic alignment sleeves,][MT-RJ in accordance with JIS C 5964-18 with thermoplastic alignment sleeves,][and][ST with metallic alignment sleeves] as indicated. Provide dust cover for adapters. Optical fiber adapters shall comply with JIS C 61300-2-2 for [500] mating cycles.

2.5.3 Optical Fiber Connectors

Provide in accordance with JIS C 61300-2-2.[ Optical fiber connectors shall be [duplex LC in accordance with JIS C 5964-20 with zirconia ceramic alignment sleeves,][duplex SC in accordance with JIS C 5964-4 and JIS C 5964-4-100 with zirconia ceramic][MT-RJ in accordance with JIS C 5964-18 with thermoplastic][ST in accordance with metallic] ferrule, epoxyless [crimp style] compatible with [62.5/125][50/125] multimode][8/125 single-mode] fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 850 nm and less than a 0.2 dB change after 500 mating cycles.]

2.5.4 Cover Plates

Telecommunications cover plates shall comply with JIS C 8435, and JIS X 5150, [JCS 5507], [JIS C 6820 and JIS C 6850]; [flush][or][oversized] design constructed of [high impact thermoplastic material][ivory][white][brown] in color[to match color of receptacle/switch cover plates specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM][302 stainless material][brass material]. Provide labeling in accordance with the paragraph LABELING in this section.

2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

Provide MUTOA(s) in accordance with JIS X 5150.

2.7 TERMINAL CABINETS

Construct of zinc-coated sheet steel, [915 by 610 by 150 mm deep][as indicated]. Trim shall be fitted with hinged door and locking latch. Doors shall be maximum size openings to box interiors. Boxes shall be provided with 16 mm backboard with two-coat varnish finish. Match trim, hardware, doors, and finishes with panelboards. Provide label and identification systems for telecommunications wiring and components.

2.8 GROUNDING AND BONDING PRODUCTS

Provide in accordance with JIS C 60364-5-54. Components shall be identified as required by applicable codes and standards. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.9 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

2.10 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's
name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.11 FIELD FABRICATED NAMEPLATES

JIS K 6911. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm thick, white with [black] [_____] center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be a minimum of 6.35 mm high normal block style.

2.12 TESTS, INSPECTIONS, AND VERIFICATIONS

2.12.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with JIS X 5150, JCS 5507, JIS C 6820 and JIS C 6850[, JIS C 6185-2 for single mode optical fiber ],[ and JIS C 6185-3 for multimode optical fiber] cables.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with JIS X 5150, JCS 5507, [JIS C 6820 and JIS C 6850, ], and UL standards as applicable. Provide cabling in a star topology network.[ Provide residential cabling in a star wiring architecture from the distribution device as required.] Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling.[ Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.]

3.1.1 Cabling

Install [UTP,][ and][ optical fiber] telecommunications cabling system as detailed in JIS X 5150, [JCS 5507, ] [JIS C 6820 and JIS C 6850, Appendix A ][ and applicable codes and standards for residential cabling]. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 110 N pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label
cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Open Cable

Use only where specifically indicated on plans for use in cable trays, or below raised floors. Install in accordance with JIS X 5150, JCS 5507 [and JIS C 6820 and JIS C 6850, Appendix A]. Do not exceed cable pull tensions recommended by the manufacturer. Copper cable not in a wireway or pathway shall be suspended a minimum of [200] mm above ceilings by cable supports no greater than [1.5] m apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300 mm shall be maintained when such placement cannot be avoided.

Plenum cable shall be used where open cables are routed through plenum areas. Cable routed exposed under raised floors shall be plenum rated. Plenum cables shall comply with flammability plenum requirements per applicable codes and standards. Install cabling after the flooring system has been installed in raised floor areas. Cable [1.8] meters long shall be neatly coiled not less than [300] mm in diameter below each feed point in raised floor areas.

3.1.1.2 Backbone Cable

a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.

b. Optical fiber Backbone Cable. Install intrabuilding backbone optical fiber in indicated pathways. Do not exceed manufacturer's recommended bending radii and pull tension. Prepare cable for pulling by cutting outer jacket 250 mm leaving strength members exposed for approximately 250 mm. Twist strength members together and attach to pulling eye. Vertical cable support intervals shall be in accordance with manufacturer's recommendations.

3.1.1.3 Horizontal Cabling

Install horizontal cabling as indicated on drawings. Do not untwist Category 6 UTP cables more than 12 mm from the point of termination to maintain cable geometry. Provide slack cable in the form of a figure eight (not a service loop) on each end of the cable, 3 m in the telecommunications room, and 304 mm in the work area outlet.

3.1.2 Pathway Installations

Provide in accordance with JIS X 5150. Provide building pathway as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Service Entrance Conduit, Overhead

Provide service entrance overhead as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEMS.
3.1.4 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.5 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Only [CMP] [and] [OFNP] type cable shall be installed in a plenum.

3.1.6 Work Area Outlets

3.1.6.1 Terminus

Terminate UTP cable in accordance with JIS X 5150, JCS 5507 and wiring configuration as specified. [Terminate fiber optic cables in accordance with JIS C 6820 and JIS C 6850]

3.1.6.2 Cover Plates

As a minimum, each outlet/connector shall be labeled as to its function and a unique number to identify cable link in accordance with the paragraph LABELING in this section.

3.1.6.3 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 304 mm of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturer's bend radius for each type of cable shall not be exceeded.

3.1.6.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.6.5 Multi-User Telecommunications Outlet Assembly (MUTOA)

Run horizontal cable in the ceiling or underneath the floor and terminate each cable on a MUTOA in each individual zone. MUTOAs shall not be located in ceiling spaces, or any obstructed area. MUTOAs shall not be installed in furniture unless that unit of furniture is permanently secured to the building structure. MUTOAs shall be located in an open work area so that each furniture cluster is served by at least one MUTOA. The MUTOA shall be limited to serving a maximum of twelve work areas. Maximum work area cable length requirements shall also be taken into account. MUTOAs must be labeled to include the maximum length of work area cables. MUTOA labeling is in addition to the labeling, or other applicable cabling administration standards. Work area cables extending from the MUTOA to the work area device must also be uniquely identified and labeled.

3.1.7 Telecommunications Space Termination

Install termination hardware required for [Category 6][ and ][optical fiber] system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.
3.1.7.1 Connector Blocks

Connector blocks shall be [cabinet][rack][wall] mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with JIS X 5150.

3.1.7.2 Patch Panels

Patch panels shall be mounted [in equipment [cabinets]][racks][on the plywood backboard] with sufficient ports to accommodate the installed cable plant plus [25][_____] percent spares.

[a. Copper Patch Panel. Copper cable entering a patch panel shall be secured to the panel [with cable ties][as recommended by the manufacturer] to prevent movement of the cable.

[b. Fiber Optic Patch Panel. Fiber optic cable loop shall be [900][_____] mm in length][provided as recommended by the manufacturer]. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.7.3 Equipment Support Frames

Install in accordance with JIS X 5150:

[a. Bracket, wall mounted. Mount bracket to plywood backboard in accordance with manufacturer's recommendations. Mount rack so height of highest panel does not exceed 1980 mm above floor.]

[b. Racks, floor mounted modular type. Permanently anchor rack to the floor in accordance with manufacturer's recommendations.]

[c. Cabinets, freestanding modular type. When cabinets are connected together, remove adjoining side panels for cable routing between cabinets. [Mount rack mounted fan in [roof][base] of cabinet.]]

[d. Cabinets, wall-mounted modular type. Mount cabinet to plywood backboard in accordance with manufacturer's recommendations. Mount cabinet so height of highest panel does not exceed 1980 mm above floor.]

3.1.8 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.9 Grounding and Bonding

Provide in accordance with JIS C 60364-5-54 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with applicable codes and standards.
Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using [thermal ink transfer process][laser printer] [____].

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers.

3.2.3 Termination Hardware

Workstation outlets and patch panel connections shall be labeled using color coded labels with identifiers.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled. Label and fire rating stamp must be unpainted.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with JIS X 5150, [JCS 5507], [JIS C 6820 and JIS C 6850]. Test equipment shall conform to JIS X 5150. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide results along with manufacturer certification for factory reel tests. Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with JIS X 5150, JCS 5507, [JIS C 6820 and JIS C 6850], [ and ][applicable codes and standards for residential cabling]. Visually confirm [Category 6,] marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts,
opens, intermittent faults, and polarity between conductors, and between
collectors and shield, if cable has overall shield. Test operation of
shorting bars in connection blocks. Test cables after termination but
prior to being cross-connected.

[[For multimode optical fiber, perform optical fiber end-to-end attenuation
tests in accordance with JIS C 6820 and JIS C 6850 and JIS C 6850 and
JIS C 6185-3 using[ Method A, Optical Power Meter and Light Source][ Method
B, OTDR] for multimode optical fiber.][ For single-mode optical fiber,
perform optical fiber end-to-end attenuation tests in accordance with
JIS C 6820 and JIS C 6850 and JIS C 6185-2 using[ Method A, Optical Power
Meter and Light Source][ Method B, OTDR] for single-mode optical fiber.]
Perform verification acceptance tests.]

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

[ a. Perform Category 6 link tests in accordance with JIS X 5150 and
JCS 5507. Tests shall include wire map, length, insertion loss, NEXT,
PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay
skew.

][ Optical fiber Links. Perform optical fiber end-to-end link tests in
accordance with JIS C 6820 and JIS C 6850.

]3.5.1.4 Final Verification Tests

Perform verification tests for UTP[ and optical fiber] systems after the
complete telecommunications cabling and workstation outlet/connectors are
installed.

[ a. Voice Tests. These tests assume that dial tone service has been
installed. Connect to the network interface device at the demarcation
point. Go off-hook and listen and receive a dial tone. If a test
number is available, make and receive a local, long distance, and DSN
telephone call.

][b. Data Tests. These tests assume the Information Technology Staff has a
network installed and are available to assist with testing. Connect to
the network interface device at the demarcation point. Log onto the
network to ensure proper connection to the network.

] -- End of Section --
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DIVISION 31 - EARTHWORK

SECTION 31 00 00

EARTHWORK

08/08

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PART 1  GENERAL

1.1  MEASUREMENT PROCEDURES

1.1.1  Excavation

The unit of measurement for excavation and borrow will be the cubic meter, computed by the average end area method from cross sections taken before and after the excavation and borrow operations, including the excavation for ditches, gutters, and channel changes, when the material is acceptably utilized or disposed of as herein specified. The measurements will include authorized excavation of rock (except for piping trenches that is covered below), authorized excavation of unsatisfactory subgrade soil, and the volume of loose, scattered rocks and boulders collected within the limits of the work; allowance will be made on the same basis for selected backfill ordered as replacement. The measurement will not include the volume of subgrade material or other material that is scarified or plowed and reused in-place, and will not include the volume excavated without authorization or the volume of any material used for purposes other than directed. The volume of overburden stripped from borrow pits and the volume of excavation for ditches to drain borrow pits, unless used as borrow material, will not be measured for payment. The measurement will not include the volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed grade.

1.1.2  Piping Trench Excavation

Measure trench excavation by the number of linear meters along the centerline of the trench and excavate to the depths and widths specified for the particular size of pipe. Replace unstable trench bottoms with a selected granular material. Include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.

1.1.3  Rock Excavation for Trenches

Measure and pay for rock excavation by the number of cubic meters of acceptably excavated rock material. Measure the material in place, but base volume on a maximum 750 mm width for pipes 300 mm in diameter or less, and a maximum width of 400 mm greater than the outside diameter of the pipe for pipes over 300 mm in diameter. Provide the measurement to include all authorized overdepth rock excavation as determined by the Contracting Officer. For manholes and other appurtenances, compute volumes of rock excavation on the basis of 300 mm outside of the wall lines of the structures.

1.1.4  Topsoil Requirements

Separate excavation, hauling, and spreading or piling of topsoil and related miscellaneous operations will be considered subsidiary obligations.
of the Contractor, covered under the contract unit price for excavation.

1.1.5 Overhaul Requirements

Allow the unit of measurement for overhaul to be the station-meter. The overhaul distance will be the distance in stations between the center of volume of the overhaul material in its original position and the center of volume after placing, minus the free-haul distance in stations. The haul distance will be measured along the shortest route determined by the Contracting Officer as feasible and satisfactory. Do no measure or waste unsatisfactory materials for overhaul where the length of haul for borrow is within the free-haul limits.

1.1.6 Select Granular Material

Measure select granular material in place as the actual cubic meters replacing wet or unstable material in trench bottoms [within the limits shown] [in authorized overdepth areas]. Provide unit prices which include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

1.2 PAYMENT PROCEDURES

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

1.2.1 Classified Excavation

Classified excavation will be paid for at the contract unit prices per cubic meter for common or rock excavation.

1.2.2 Piping Trench Excavation

Payment for trench excavation will constitute full payment for excavation and backfilling, [including specified overdepth] except in rock or unstable trench bottoms.

1.2.3 Rock Excavation for Trenches

Payment for rock excavation will be made in addition to the price bid for the trench excavation, and will include all necessary drilling and all incidentals necessary to excavate and dispose of the rock. Select granular material, used as backfill replacing rock excavation, will not be paid for separately, but will be included in the unit price for rock excavation.

1.2.4 Unclassified Excavation

Unclassified excavation will be paid for at the contract unit price per cubic meter for unclassified excavation.

1.2.5 Classified Borrow

Classified borrow will be paid for at the contract unit prices per cubic meter for common or rock borrow.
1.2.6 Unclassified Borrow

Unclassified borrow will be paid for at the contract unit price per cubic meter for unclassified borrow.

1.2.7 Authorized Overhaul

The number of station-meters of overhaul to be paid for will be the product of number of cubic meters of overhaul material measured in the original position, multiplied by the overhaul distance measured in stations of 100 meters and will be paid for at the contract unit price per station-meter for overhaul in excess of the free-haul limit as designated in paragraph DEFINITIONS.

1.2.8 Sheeting and Bracing

Sheeting and bracing, when shown or authorized by the Contracting Officer to be left in place, will be paid for as follows: [____].

1.2.8.1 Timber Sheeting

Timber sheeting will be paid for as the number of board feet of lumber below finish grade measured in place prior to backfilling. Include in the measurement sheeting wasted when cut off between the finished grade and 300 mm below the finished grade.

1.2.8.2 Steel Sheeting and Soldier Piles

Steel sheeting, soldier piles, and steel bracing will be paid for according to the number of pounds of steel calculated. Calculate the steel by multiplying the measured in-place length in meters below finish grade by the unit weight of the section in kg per meter. Obtain unit weight of rolled steel sections from recognized steel manuals. [Included in the measurement sheeting wasted when cut off between the finished grade and a distance of up to [_____] meters below the finished grade.]

1.3 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. [Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.] [Ground water elevation is [____] meters below existing surface elevation.]

d. [Ground water elevation is [____] meters below existing surface elevation.]

e. [Material character is indicated by the boring logs.]

f. [Hard materials [and rock] [will not] [will] be encountered [in [_____] percent of the excavations] [at [_____] meter below existing surface elevations]].
1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

- JIS A 1102 (2014) Method of Test for Sieve Analysis of Aggregates
- JIS A 1103 (2014) Method of Test for Amount of Material Passing Test Sieve 75 µm in Aggregates
- JIS A 5005 (2009) Crushed Stone and Manufactured Sand for Concrete

JAPAN MINISTRY OF THE ENVIRONMENT (MOE)

- Notification No.46 (2001) Environmental Quality Standards for Soil Contamination

JAPANESE GEOTECHNICAL SOCIETY (JGS)


U.S. DEPARTMENT OF DEFENSE HEADQUARTERS, U.S. FORCES JAPAN (USFJ)

- JEGS (2018) Japan Environmental Governing Standards

1.5 DEFINITIONS

1.5.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by JGS 0051 as G,
G-M, G-C, [G-O], [G-V], GM, GC, [GO], [GV], S, S-M, S-C, [S-O], [S-V], SM, SC, [SO], [SV], ML, MH, CL, CH, [OL], [OH], [OV], [VH1], [VH2].
Satisfactory materials for grading comprise stones less than 200 mm, except for fill material for pavements and railroads which comprise stones less than 75 mm in any dimension.

1.5.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.5.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in JGS 0051 as G, G-M, G-C, S, S-M, S-C. Cohesive materials include materials classified as GC, SC, ML, CL, MH, CH. Materials classified as GM, SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with JIS A 1205, JIS A 1102 and JIS A 1103.

1.5.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in JIS A 1210 (Methods C,D,E - non repeating method) abbreviated as a percent of laboratory maximum density (Modified Proctor Test).

1.5.5 Overhaul

Overhaul is the authorized transportation of satisfactory excavation or borrow materials in excess of the free-haul limit of [_____] stations. Overhaul is the product of the quantity of materials hauled beyond the free-haul limit, and the distance such materials are hauled beyond the free-haul limit, expressed in station meters.

1.5.6 Topsoil

Material suitable for topsoils obtained from [offsite areas] [excavations] [areas indicated on the drawings] is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than 25 mm diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.5.7 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than [_____] mm in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.
1.5.8 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding [0.375] cubic meter in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling that is performed merely to increase production.

1.5.9 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.5.10 Select Granular Material

1.5.10.1 General Requirements

Select granular material consist of materials classified as [G], [G-M], [G-C], [S], [S-M], [S-C] or [_____] by JGS 0051 where indicated. The liquid limit of such material must not exceed [35] percent when tested in accordance with JIS A 1205. The plasticity index must not be greater than [12] percent when tested in accordance with JIS A 1205, and not more than [35] percent by weight may be finer than 75 micrometers sieve when tested in accordance with JIS A 1103. Provide a minimum coefficient of permeability of [0.01] mm per second when tested in accordance with JIS A 1218.

1.5.10.2 California Bearing Ratio Values

[Bearing Ratio: Provide Design CBR ratio in accordance with JIS A 1211 for a laboratory soaking period of not less than 4 days. Provide [_____] percent maximum expansion.] Conform the combined material to the following sieve analysis:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>63 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>40 - 85</td>
</tr>
<tr>
<td>2.00 mm</td>
<td>20 - 80</td>
</tr>
<tr>
<td>425 µm</td>
<td>10 - 60</td>
</tr>
<tr>
<td>75 µm</td>
<td>5 - 25</td>
</tr>
</tbody>
</table>

1.5.11 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks [_____] mm or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than [_____] mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.
1.5.12 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than [_____] when tested in accordance with JIS A 1205 or have expansion/swelling ratios equal to or greater than [_____] when tested in accordance with JIS A 1211.

1.5.13 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with a maximum particle size of [_____] mm and less than 5 percent passing the 0.075 mm size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.5.14 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.6 SYSTEM DESCRIPTION

Subsurface soil boring logs are [shown on the drawings] [appended to the SPECIAL CONTRACT REQUIREMENTS]. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at [______]. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.6.1 Classification of Excavation

[No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.] [Finish the specified excavation on a classified basis, in accordance with the following designations and classifications.]

1.6.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.6.1.2 Rock Excavation

Submit notification of encountering rock in the project. Include rock excavation with excavating, grading, disposing of material classified as rock, and the satisfactory removal and disposal of boulders 1/2 cubic meter or more in volume; solid rock; rock material that is in ledges, bedded deposits, and unstratified masses, which cannot be removed without systematic drilling; firmly cemented conglomerate deposits possessing the characteristics of solid rock impossible to remove without systematic drilling; and hard materials (see Definitions). Include the removal of any concrete or masonry structures, except pavements, exceeding 1/2 cubic meter in volume that may be encountered in the work in this classification. If at any time during excavation, including excavation from borrow areas, the Contractor encounters material that may be classified as rock excavation, uncover such material and notify the Contracting Officer. Do not proceed with the excavation of this material until the Contracting Officer has classified the materials as common excavation or rock excavation and has taken cross sections as required. Failure on the part of the Contractor to
uncover such material, notify the Contracting Officer, and allow ample time for classification and cross sectioning of the undisturbed surface of such material will cause the forfeiture of the Contractor's right of claim to any classification or volume of material to be paid for other than that allowed by the Contracting Officer for the areas of work in which such deposits occur.

1.6.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.7 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
- Shoring; G[, [_____]]
- Dewatering Work Plan; G[, [_____]]

SD-06 Test Reports
- Testing
- Borrow Site Testing

Within 24 hours of conclusion of physical tests, submit [_____] copies of test results, including calibration curves and results of calibration tests.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Perform tests and verify threshold values in accordance with JAPAN Ministry of the Environment Notification No.46 guidelines and JEGS. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide [polyethylene plastic] [and] [metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic] warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 75 mm minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or
similar wording. Provide permanent color and printing, unaffected by moisture or soil.

<table>
<thead>
<tr>
<th>Warning Tape Color Codes</th>
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<tbody>
<tr>
<td>Red</td>
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<tr>
<td>Yellow</td>
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<tr>
<td>Orange</td>
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<tr>
<td>Blue</td>
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<tr>
<td>Green</td>
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<tr>
<td>White</td>
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<tr>
<td>Gray</td>
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</tbody>
</table>

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.08 mm and a minimum strength of 10.3 MPa lengthwise, and 8.6 MPa crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.10 mm, and a minimum strength of 10.3 MPa lengthwise and 8.6 MPa crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 920 mm deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide [Bedding material] [Grout] [Filter fabric] and rock conforming to [these requirements] [[_____] local Standard] for construction indicated.

2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, [or poorly graded] with a maximum particle size of 50 mm. Compose material of tough, durable particles. Allow fines passing the 75 micrometers standard sieve with a plasticity index less than six.

2.4.2 Grout

Provide durable grout composed of cement, water, an air-entraining
admixture, and sand mixed in proportions of one part portland cement to [two] [_____] parts of sand, sufficient water to produce a workable mixture, and an amount of admixture which will entrain sufficient air, as determined by the Contracting Officer. Mix grout in a concrete mixer. Allow a sufficient mixing time to produce a mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming.

2.4.3 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of [68] [_____] kg and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 0.91 kg or less each. Provide rock with a minimum specific gravity of [2.50] [_____] . Do not permit the inclusion of more than trace [1 percent] [_____] quantities of dirt, sand, clay, and rock fines.

2.5 CAPELLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to JIS A 5005 for fine aggregate grading with a maximum of 3 percent by weight passing JIS A 1103, 75 micrometers sieve, [or] [37.5 mm and no more than 2 percent by weight passing the 4.75 mm size sieve] [or coarse aggregate with "S-x" designation (where x is the maximum nominal gravel size) in accordance with JIS A 5001].

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of [100] [_____] mm. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 50 mm in diameter, and other materials that would interfere with planting and maintenance operations. [Stockpile in locations indicated] [Remove from the site] any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas.
During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on Drawing Sheet No. [______]. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 1 meter from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 300 mm above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity [and] [or] provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 0.9 m of the
foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least [_____] m below the working level. [Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.] [Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.] [Relieve hydrostatic head in previous zones below subgrade elevation in layered soils to prevent uplift.]

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than [_____] meters high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls more than [_____] meters high. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 600 mm plus pipe outside diameter (O.D.) for pipes of less than 600 mm inside diameter, and do not exceed 900 mm plus pipe outside diameter for sizes larger than 600 mm inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of [_____] mm or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where [overdepth is not indicated and] unyielding material is encountered in the bottom of the trench, remove such material [_____] mm below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.
3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures [sufficient to leave at least 300 mm clear between the outer structure surfaces and the face of the excavation or support members.] [of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.] Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. [Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company.] [Excavation made with power-driven equipment is not permitted within [600] [_____] mm of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer.] Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of JIS A 1210 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas [shown on Drawing Sheet No. [_____] [within the limits of the project site, selected by the Contractor] [or] [from approved private sources]. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do
not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit or borrow areas to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory [and unsatisfactory] [and wasted materials] as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes
unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. [For pile foundations, stop the excavation at an elevation of from 150 to 300 mm above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown.] Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 150 mm before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 150 mm, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 300 mm and compact it as specified for the adjacent fill.

3.8.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary [to plus or minus [_____] percent of optimum moisture] [to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used].

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the

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completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 300 mm below finished grade; under pavements and slabs, bury tape 150 mm below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 300 mm above the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 0.9 m of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over its entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, in successive horizontal layers of loose material not more than 200 mm in depth. Compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials in accordance with JIS A 1210, to prevent wedging action or eccentric loading upon or against the structure. Backfill material must be within the range of -2 to +2 percent of optimum moisture content at the time of compaction.

Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown. [Backfill the trench to [_____] meters above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test.] [Do not backfill the trench until all specified tests are performed.]

3.11.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.11.1.2 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 150 mm loose thickness.

3.11.1.3 Bedding and Initial Backfill

[Provide bedding of the type and thickness shown.] Place initial backfill
material and compact it with approved tampers to a height of at least 300 mm above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with as shown in design drawings, except as specified herein. Compact backfill to top of pipe to 90 percent of JIS A 1210 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

3.11.1.3.1 Class I

Angular, 6 to 40 mm, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

3.11.1.3.2 Class II

Coarse sands and gravels with maximum particle size of 40 mm, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types G, G-M, G-C, S, S-M, S-C are included in this class as specified in JGS 0051.

3.11.1.3.3 Sand

Clean, coarse-grained sand classified as [_____] in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL, [gradation [_____] of the [local Standard] or [S], [S-M], [S-C] by JGS 0051 for [bedding] [and] [backfill] [as indicated].

3.11.1.3.4 Gravel and Crushed Stone

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as [_____] in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL, [gradation [_____] of the [DOT] [State Standard] or having a classification of [G], [G-M], [G-C] in accordance with JGS 0051 for [bedding] [and] [backfill] [as indicated]. [Do not exceed maximum particle size of 75 [_____] mm.]

3.11.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

3.11.1.4.1 Roadways, Railroads, and Airfields

Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

3.11.1.4.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 300 mm loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. [Allow water flooding or jetting methods of compaction for granular noncohesive backfill material. Do not allow water jetting to penetrate the initial backfill.] [Do not permit compaction by water flooding or jetting.] Apply this requirement to all other areas not specifically designated above.
3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed [and the concrete has been allowed to cure for [_____] days], place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 450 mm of cover in rock excavation and a minimum 600 mm of cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of [_____] meters from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. [For fire protection yard mains or piping, an additional [_____] mm of cover is required.]

3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 6.3 mm in any dimension.

3.12.4 Electrical Distribution System

Provide a minimum cover of 600 mm from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.5 Sewage Absorption Trenches or Pits

3.12.5.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation [such that 100 percent passes the 50 mm sieve and zero percent passes the 12.5 mm sieve.] [conforming to the requirements of gradation [4.75 mm] [_____] for coarse aggregate in JIS A 5005.]

3.12.5.2 Cover

[Filter fabric] [Concrete] [or a layer of straw at least 50 mm thick] as indicated.

3.12.6 Rip-Rap Construction

Construct rip-rap [on bedding material] [on filter fabric] [with grout] [in accordance with [_____] local Standard, paragraph [_____]] in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 30 mm.
3.12.6.1 Bedding Placement

Spread [filter fabric] bedding material uniformly to a thickness of at least [75] mm on prepared subgrade as indicated. [Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.]

3.12.6.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above. [For grouted rip-rap, hand-place surface rock with open joints to facilitate grouting and do not fill smaller spaces between surface rock with finer material. Provide at least one "weep hole" through grouted rip-rap for every 4.65 square meters of finished surface. Provide weep holes with columns of bedding material, 100 mm in diameter, extending up to the rip-rap surface without grout.]

3.12.6.3 Grouting

[Prior to grouting, wet rip-rap surfaces. Grout rip-rap in successive longitudinal strips, approximately 3 m in width, commencing at the lowest strip and working up the slope. Distribute grout to place of final deposit and work into place between stones with brooms, spades, trowels, or vibrating equipment. Take precautions to prevent grout from penetrating bedding layer. Protect and cure surface for a minimum of 7 days.]

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. Place the material in successive horizontal layers of loose material not more than 200 mm in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density in accordance with JIS A 1210 for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Backfill material must be within the range of -2 to +2 percent of optimum moisture content at the time of compaction, when required.

Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.13.2 Rock Embankments

Construct rock embankments from material classified as rock excavation, as defined above, placed in successive horizontal layers of loose material not more than [_____] mm in depth. Do not use pieces of rock larger than
[_____] mm in the greatest dimension. Spread each layer of material uniformly, completely saturate, and compact to a minimum density of [_____] kg/cubic meter. Adequately bond each successive layer of material to the material on which it is placed. Finish compaction with vibratory compactors weighing at least [_____] metric tons, heavy rubber-tired rollers weighing at least [_____] metric tons, or steel-wheeled rollers weighing at least [_____] metric tons. [Do not use rock excavation as fill material for the construction of pavements.] [In embankments on which pavements are to be constructed, do not use rock above a point [_____] mm below the surface of the pavement.]

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. [After stripping,] proof roll the existing subgrade of the [_____] with six passes of a [dump truck loaded with 6 cubic meters of soil] [13.6 meter tons, pneumatic-tired roller.] Operate the [roller] [truck] in a systematic manner to ensure the number of passes over all areas, and at speeds between 4 to 5.5 km/hour. [When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes.] Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material [as directed by the Contracting Officer] [to a depth of [_____] mm ] and replace with [fill and backfill] [select] material. [Prepare bids based on replacing approximately [_____] square meters, with an average depth of [_____] mm at various locations.]

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aeration required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 150 mm below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. [After rolling, the surface of the subgrade for roadways shall not show deviations greater than 13 mm when tested with a 4 m straightedge applied both parallel and at right angles to the centerline of the area.] [After rolling, do not show deviations for the surface of the subgrade for airfields greater than [_____] mm when tested with a [_____] meter straightedge applied both parallel and at right angles to the centerline of the area.] Do not vary the elevation of the finish subgrade more than 15 mm from the established grade and cross section.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least [_____] percent of laboratory maximum density.
3.14.3.1 Subgrade for Railroads

Compact subgrade for railroads to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials in accordance with JIS A 1210.

3.14.3.2 Subgrade for Pavements

Compact subgrade for pavements to at least [_____] percentage laboratory maximum density in accordance with JIS A 1210 for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top [_____] mm of subgrade.

3.14.3.3 Subgrade for Shoulders

Compact subgrade for shoulders to at least [_____] percentage laboratory maximum density in accordance with JIS A 1210 for the [depth below the surface of shoulder shown] [full depth of the shoulder].

3.14.3.4 Subgrade for Airfield Pavements

Compact top 600 mm below finished pavement or top 300 mm of subgrades, whichever is greater, to [100] [_____] percent of JIS A 1210; compact fill and backfill material to [100] [_____] percent of JIS A 1210.

3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 30 mm of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.
3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.16.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16.3 Grading Around Structures

Construct areas within 1.5 m outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 50 mm depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of [_____] mm and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from [offsite areas] [areas indicated].

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with [JIS A 1214][JGS 1614]. [When JGS 1614 is used, check the calibration curves and adjust using only the sand cone method as described in JIS A 1214. results in a wet unit weight of soil in determining the moisture content of the soil when using this method. Since JGS 1614 uses equipment that contains radiactive materials, notify the Base BioEnvironmental and/or Environmental Office and the Contracting Officer if this method is used.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in JGS 1614; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer.] When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet

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specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 Fill and Backfill Material Gradation

One test per [_____] cubic meters stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with [JIS A 1102] [JIS A 1103].

3.18.2 In-Place Densities

a. One test per [_____] square meters, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per [_____] square meters, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per [_____] linear meters, or fraction thereof, of each lift of embankment or backfill for [roads] [airfields].

d. One test per [_____] linear meters, or fraction thereof, of each lift of embankment or backfill for railroads.

3.18.3 Check Tests on In-Place Densities

If JGS 1614 is used, check in-place densities by JIS A 1214 as follows:

a. One check test per lift for each [_____] square meters, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.

b. One check test per lift for each [_____] square meters, of fill or backfill areas compacted by hand-operated machines.

c. One check test per lift for each [_____] linear meters, or fraction thereof, of embankment or backfill for [roads] [airfields].

d. One check test per lift for each [_____] linear meters, or fraction thereof, of embankment or backfill for railroads.

3.18.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform tests as required, to meet compaction requirements, per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.
3.18.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per [_____] cubic meters of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to [_____] meters above the top of the pipe] [the finished grade surface], inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 900 mm, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

Remove surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber [to a Government disposal area [as indicated][which is located within a haul distance of [_____] km]][from Government property to an approved location ] [from Government property and delivered to a licensed/permitted facility or to a location approved by the Contracting Officer].

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Pile and Driving Equipment Data Form

pile driving log

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1108 (2018) Method of Test for Compressive Strength of Concrete

JIS A 1132 (2014) Method of Making and Curing Concrete Specimens

JIS A 5373 (2016) Precast Prestressed Concrete Products

JIS A 7201 (2009) Standard Practice for Execution of Spun Concrete Piles

JAPANESE GEOTECHNICAL SOCIETY (JGS)


JGS 1831 (2010) Method for Lateral Load Test of Piles

JAPAN MINISTRY OF THE ENVIRONMENT (MOE)

Notification No.46 (2001) Environmental Quality Standards for Soil Contamination

[1.2 LUMP SUM PAYMENT]

Base bids upon providing the number, size, capacity, and length of piles as indicated on the [drawings.] [following Table I:
The contract price for piling shall include the cost of all necessary equipment, tools, material, labor, and supervision required to: deliver, handle, install, cut-off, dispose of any cut-offs, and meet the applicable contract requirements. The contract price also includes mobilization, pre-drilling, and redriving heaved piles. If, in redriving, it is found that any pile is not of sufficient length to provide the capacity specified, notify the Contracting Officer, who reserves the right to increase or decrease the total length of piles to be furnished and installed by changing the pile locations or elevations, requiring the installation of additional piles, or directing the omission of piles from the requirements shown and specified. Should total number of piles or number of each length vary from that specified as the basis for bidding, an adjustment in the contract price or time for completion, or both, will be made in accordance with the contract documents. Payment for piles will be based on successfully installing piles to both the minimum tip elevation and satisfying the acceptance criteria identified herein. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles; any portion of a pile remaining above the cut-off elevation; backdriving; cutting off piles; splicing; build-ups; any cut-off length of piles; or other excesses beyond the assumed pile length indicated for which the Contractor is responsible.

1.2.1 Acceptance Criteria

Safe design capacity for piles is [_____] KiloNewtons (KN). Piles shall be driven to a minimum depth of [_____] feet below cut-off elevation, and to such additional depth as required to obtain a bearing capacity of not less than [_____] KN.

The following formulas are presented only as a guide to aid in establishing the controlling penetration per blow, which, together with the minimum depth of penetration will serve to determine the required minimum depth of penetration of each individual pile:

\[ R = \frac{(2WH)}{(5s + 0.1)} \]

Where:
- \( R \) - is the approximate allowable pile load in KN
- \( W \) - is the weight of the hammer in KN
- \( H \) - is the height of fall of hammer in m
- \( S \) - is the average of penetration for the last ten blows in m

1.3 MEASUREMENT AND PAYMENT

[For unit price bid, see SF 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items."] [Section 00 22 13.00 20 SUPPLEMENTARY INSTRUCTIONS TO OFFERORS.

Requirements of FAR 52.211-18 Variation in Estimated Quantity shall not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which price shall include items incidental to furnishing and driving the piles including...
mobilization and demobilization, [jetting] [predrilling] [probing],
redriving uplifted piles, [an additional 1.5 m in furnished length for any
test pile not driven beyond estimated pile length,] and cutting off piles
at the cut-off elevation. [The cost for additional length for the test
piles shall be included in the total unit price cost for the job.] Payment
will be made for job [and test piles] at the bid unit price for the length
do pile, from tip to final cut-off, actually provided, excluding buildups
and splices directed by the Contracting Officer to be made. Should the
actual cumulative pile length driven (tip to cut-off) vary more than 25
percent from the total pile length specified as a basis for bidding, at the
direction of the Contracting Officer, the unit price per unit length will
be adjusted in accordance with provisions of FAR 52.236–2 Differing Site
Conditions.

1.3.1 Pile Cut-Off

Where the tip to cut-off length is less than that calculated from the
results of test pile driving [and load testing], payment for that portion
of pile not driven will be made at 75 percent of the bid unit price and no
other payment will be made for making the cut-off.

1.3.2 Pile Build-ups

Payment for buildups will be made at 125 percent of the bid unit price.

1.3.3 Pile Splices

Payment for splices, as specified, will be made at 25 times the unit price
per 300 mm bid for 250 mm piling, 22 times the unit price per 300 mm bid for
300 mm piling, and 18 times the unit price per 300 mm bid for all other
piling.

1.3.4 Pulled Piles

Piles required to be pulled at no fault of the Contractor will be paid for
at the bid unit price for furnishing and driving the pile in its original
position plus 25 percent of the amount to cover the cost of pulling. Such
pulled piles when redriven will be paid for at 25 percent of the bid unit
price for the length driven.

[1.3.5 Pile Load Test

Payment for each acceptably provided complete test loading of a single pile
will be made at the contract unit price per test, which price shall include
furnishing, placing, and removing testing equipment, and placing and
removing test loads. At the direction of the Contracting Officer, load
tests may be waived at a credit to the Government of the unit price bid
therefore.

]][1.4 UNIT PRICES

1.4.1 Furnishing and Delivering Prestressed Concrete Piles

1.4.1.1 Payment

Payment will be made for costs associated with furnishing and delivering
the required lengths of permanent prestressed concrete piles, [including
H-pile extensions,] which includes costs of furnishing and delivering piles
to the work site. No payment will be made for the driving head or lengths
of piles exceeding required lengths. No payment will be made for piles damaged during delivery, storage, or handling to the extent that they are rendered unsuitable for the work, in the opinion of the Contracting Officer.

1.4.1.2 Measurement

Furnishing and delivering permanent prestressed concrete piles will be measured for payment by the linear meter of piles required below the cut-off elevation as [determined by the Contracting Officer and furnished to the Contractor] [indicated].

1.4.1.3 Unit of Measure

Unit of measure: linear meter.

1.4.2 Driving Prestressed Concrete Piles

1.4.2.1 Payment

Payment will be made for costs associated with driving permanent prestressed concrete piles, which includes costs of handling, driving, [and splicing of piles,] [performing dynamic testing, interpreting data and submitting reports,] measuring heave, redriving heaved piles, removal of [build-ups] driving heads or cutting off piles at the cut-off elevation and removing from the work site, compiling and submitting pile driving records, backfilling voids around piles, and any other items incidental to driving piles to the required elevation.

1.4.2.2 Measurement

Permanent prestressed concrete piles will be measured for payment for driving on the basis of lengths, to the nearest hundredth of a linear meter, along the axis of each pile acceptably in place below the cut-off elevation shown.

1.4.2.3 Unit of Measure

Unit of measure: linear meter.

1.4.3 Pulled Prestressed Concrete Piles

1.4.3.1 Payment

Payment will be made for costs associated with piles pulled at the direction of the Contracting Officer and found to be undamaged. The cost of furnishing and delivering pulled and undamaged piles will be paid for at the applicable contract unit price for payment item "Furnishing and Delivering Prestressed Concrete Piles". The cost of driving pulled and undamaged piles will be paid for at the applicable contract unit price for payment item "Driving Prestressed Concrete Piles". The cost of pulling pulled and undamaged piles will be paid for at twice the applicable contract unit price for payment item "Driving Prestressed Concrete Piles", which includes backfilling any remaining void. The cost of redriving pulled and undamaged piles will be paid for at the applicable contract unit price for payment item "Driving Prestressed Concrete Piles". No payment will be made for furnishing, delivering, driving, pulling, and disposing of piles, including pile driving points, pulled and found to be damaged and backfilling voids. New piles replacing damaged piles will be paid for at the applicable contract unit price for payment items "Furnishing and
Delivering Prestressed Concrete Piles" and "Driving Prestressed Concrete Piles".

1.4.3.2 Measurement

Furnishing and delivering pulled and undamaged permanent prestressed concrete piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph FURNISH AND DELIVER PRESTRESSED CONCRETE PILES. Pulling undamaged prestressed concrete piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph DRIVING PRESTRESSED CONCRETE PILES. Redriving pulled undamaged prestressed concrete piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph DRIVING PRESTRESSED CONCRETE PILES. New piles replacing damaged piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraphs FURNISH AND DELIVER PRESTRESSED CONCRETE PILES and DRIVING PRESTRESSED CONCRETE PILES.

1.4.3.3 Unit of Measure

Unit of measure: linear meter.

1.4.4 [Prestressed Concrete Pile Driving Tests]

1.4.4.1 Payment

Payment will be made for costs associated with furnishing, delivering, driving, pulling, and disposing of driven test piles, [including [pile driving points] [and] [splices]]; conducting pile driving tests; backfilling voids around piles; compiling pile driving test records [; performing dynamic testing; interpreting data; and submitting reports].

1.4.4.2 Measurement

Prestressed concrete pile driving tests will be measured for payment on the basis of the applicable contract unit price per pile driving test.

1.4.4.3 Unit of Measure

Unit of measure: each.

1.4.5 [Prestressed Concrete Piles for Load Tests]

1.4.5.1 Payment

Payment will be made for costs associated with furnishing, delivering, driving, pulling, and disposing of load test piles [including [pile driving points] [and] [splices]]; backfilling voids around piles; compiling pile driving records [; furnishing, fabricating, and mounting of strain rods and protective assembly] [; furnishing, fabricating, and mounting of inclinometer and inclinometer protective assembly] [; performing dynamic testing; interpreting data; and submitting reports]. No additional payment will be made for load test piles incorporated in the permanent work other than as provided.

1.4.5.2 Measurement

Prestressed concrete piles for load tests will be measured for payment on the basis of the applicable contract unit price per load test pile.
1.4.5.3 Unit of Measure

Unit of measure: each.

1.4.6 [Prestressed Concrete Pile Compressive Load Tests]

1.4.6.1 Payment

Payment will be made for costs associated with prestressed concrete pile compressive load tests, including material and labor for fabricating and furnishing load frames; calibrating load cells and hydraulic jacks; furnishing specified test equipment; installing strain rods; placing and removing test loads and test equipment; recording, reducing, and submitting test data; and compiling and submitting pile load test reports. No payment will be made for rejected pile compressive load tests.

1.4.6.2 Measurement

Prestressed concrete pile compressive load tests will be measured for payment on the basis of the applicable contract unit price per load test.

1.4.6.3 Unit of Measure

Unit of measure: each.

1.4.7 [Prestressed Concrete Pile Tensile Load Tests]

1.4.7.1 Payment

Payment will be made for costs associated with prestressed concrete pile tensile load tests, including material and labor for fabricating and furnishing load frames; calibrating load cells and hydraulic jacks; furnishing specified test equipment; installing strain rods; placing and removing test loads and test equipment; recording, reducing, and submitting test data; and compiling and submitting pile load test reports. No payment will be made for rejected pile tensile load tests.

1.4.7.2 Measurement

Prestressed concrete pile tensile load tests will be measured for payment on the basis of the applicable contract unit price per number of tensile load test.

1.4.7.3 Unit of Measure

Unit of measure: each.

1.4.8 [Prestressed Concrete Pile Lateral Load Tests]

1.4.8.1 Payment

Payment will be made for costs associated with prestressed concrete pile lateral load tests, including material and labor for fabricating and furnishing load frames; calibrating load cells and hydraulic jacks; furnishing specified test equipment; installing inclinometers; placing and removing test loads and test equipment; recording, reducing, and submitting test data; and compiling and submitting pile load test reports. No payment will be made for rejected pile lateral load tests.
1.4.8.2 Measurement

Prestressed concrete pile lateral load tests will be measured for payment on the basis of the applicable contract unit price per lateral load test.

1.4.8.3 Unit of Measure

Unit of measure: each.

1.4.9 [Pulled Load Test Prestressed Concrete Piles]

1.4.9.1 Payment

Payment will be made for costs associated with load test prestressed concrete piles pulled prior to load testing at the direction of the Contracting Officer and found to be undamaged. The cost of furnishing, delivering, driving, and pulling undamaged load test piles will be paid for at the applicable contract unit price for payment item "Prestressed Concrete Piles for Load Tests". The cost of pulling undamaged load test piles the second time after redriving and testing will be paid for at twice the applicable contract unit price for payment item "Driving Prestressed Concrete Piles". The cost of redriving pulled undamaged load test piles will be paid for at the applicable contract unit price for payment item "Driving Prestressed Concrete Piles". No payment will be made for furnishing, delivering, driving, pulling, and disposing of load test piles pulled at the direction of the Contracting Officer and found to be damaged. New load test piles replacing damaged piles will be paid for at the applicable contract unit price for payment item "Prestressed Concrete Piles for Load Tests".

1.4.9.2 Measurement

Pulled undamaged load test prestressed concrete piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph PRESTRESSED CONCRETE PILES FOR LOAD TESTS. Pulling undamaged load test prestressed concrete piles the second time after redriving and testing will be measured for payment as specified in paragraph UNIT PRICES, subparagraph DRIVING PRESTRESSED CONCRETE PILES. Redriving pulled undamaged prestressed concrete piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph DRIVING PRESTRESSED CONCRETE PILES. New load test prestressed concrete piles replacing damaged piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph PRESTRESSED CONCRETE PILES FOR LOAD TESTS.

1.4.9.3 Unit of Measure

Unit of measure: as specified in paragraph UNIT PRICES, subparagraphs DRIVING PRESTRESSED CONCRETE PILES and PRESTRESSED CONCRETE PILES FOR LOAD TESTS, respectfully.

1.4.10 [Prestressed Concrete Pile Splices]

1.4.10.1 Payment

Payment will be made for costs associated with prestressed concrete pile splices, including all plant, labor, and material required to make the splice.
1.4.10.2 Measurement

Prestressed concrete pile splices will be measured for payment on the basis of the applicable contract unit price per pile splice.

1.4.10.3 Unit of Measure

Unit of measure: each.

1.5 PILE REQUIREMENTS

Provide precast prestressed concrete piles per JIS A 5373. Production of piles shall be in accordance with JIS A 5373. The Contractor's Geotechnical Consultant will determine and list "calculated" tip elevations or driving resistance for each pile from test pile data. This information will be given to the Contractor no later than 7 days from receipt of complete test data. Use this list as the basis for ordering the piles. Do not order piles until list is provided by the Contractor's Geotechnical Consultant. [Test piles shall be 1.5 [_____] meter longer than the bid length.]

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Procedures; G[, [____]]

[ Geotechnical Consultant Documentation; G[, [____]]

][ Wave Equation Analysis; G[, [____]]

] Order List; G[, [____]]

Precasting manufacturer's quality control procedures; G[, [____]]

Provide instructions and procedures for the processes of Dynamic Pile Testing, Inspection and Monitoring of piles during installation and testing.

SD-02 Shop Drawings

Piles; G[, [____]]

SD-03 Product Data

Pile Driving Equipment; G[, [____]]

Submit descriptions of pile driving equipment, including hammers, power packs, driving helmets, cap blocks, pile cushions, leads, extractors, jetting equipment, and preboring equipment at least 30 days prior to commencement of work.
SD-05 Design Data

Concrete mix design; G[,] [______]

Submit a concrete mix design before concrete is placed, for each type of concrete used for the piles.

Cement milk mix design; G

SD-06 Test Reports

[ Silica Fume; G; G, [______]]

Concrete Compressive Strength; G[,] [______]

Cement milk Compressive Strength; G

[ Test piles; G[,] [______]]

[ Load tests; G[,] [______]]

Submit concrete cylinder compressive strength test results. [Submit test pile records] [and] [load test data].

[ Dynamic Pile Analysis; G[,] [______]]

Submit a summary report of dynamic test results for test piles within [7][______] calendar days of completing field work. [For permanent piles, submit a field summary report within one (1) day of testing. Submit a typed report summarizing the results of dynamic testing of permanent piles on a monthly basis.]

SD-11 Closeout Submittals

Pile records; G[,] [______]

Submit pile [and test pile] records.[ Submit load test data and results.]

1.7 QUALITY ASSURANCE

1.7.1 Piles

Prepare in accordance with JIS A 5373 and JIS A 7201. Indicate placement of reinforcement including tendons. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. [Provide certification of a Professional Engineer registered in any jurisdiction of the U. S. or its territories or Japan, that layout and details of reinforcement and tendons conform with that shown on the structural design drawings.]

1.7.2 Quality Control Procedures

Submit the precasting manufacturer's quality control procedures and inspection records established in accordance with JIS A 5373.
1.7.3 Installation Procedures

a. Submit information on the type of equipment proposed to be used, proposed methods of operation, pile driving plan including proposed sequence of driving, and details of all pile driving equipment and accessories.

b. Provide details of pile driving equipment and a Wave Equation Analysis of pile drivability for selection of the hammer along with a statement of driving procedures. The Wave Equation Analysis is to be completed by the Contractor's Geotechnical Consultant for each test pile location where different subsurface conditions exist and is to include the following information pertaining to the proposed pile driving equipment:

1. Complete Pile and Driving Equipment Data Form, (which can be downloaded at: http://www.wbdg.org/FFC/NAVGRAPH/graphtoc.pdf) for each proposed pile hammer and pile type combination.

2. Copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analysis shall be run at the estimated tip elevation as well as other required elevations to define maximum stress levels in the pile during driving.

c. Provide detailed procedures for conducting the dynamic pile load test and equipment to be used for conducting the load test. The detailed description shall explain how specific information of pile performance will be evaluated.

1.7.4 Geotechnical Consultant Documentation

The services of an independent, Registered Professional Geotechnical Engineer, experienced in soil mechanics and Pile Dynamic Analysis, shall be hired by the Contractor to observe test pile installation and job pile installation as specified herein. The Geotechnical Consultant shall be independent of the Contractor and shall have no employee of employer relationship which could constitute a conflict of interest.

1.7.5 Concrete Mix Design

Certify, using a Government-approved independent commercial testing laboratory, that proportioning of mix is in accordance with JIS A 5373 for specified strength and is based on aggregate data which has been determined by laboratory tests during last twelve months. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolan, ground slag, and admixtures; and applicable reference specifications. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted.

1.7.6 Load Test Supporting Data

Submit Jack calibration records, a testing arrangement description and diagram, and the proposed loading sequence.

1.7.7 Silica Fume Manufacturer's Representative

Provide statement that the manufacturer's representative will be present at plant to ensure proper mix, including high range water reducer (HRWR), and
batching methods.

1.8 DELIVERY, STORAGE, AND HANDLING

Piles shall be stored, handled, and transported in accordance with JIS A 5373 except as follows. Methods used for handling and storage of piles shall be such that the piles are not subjected to excessive bending stress, cracking, spalling, or other damage.

1.8.1 Damaged Piles

The Contractor shall inspect each pile for sweep and structural damage such as cracking and spalling before transporting them to the project site and immediately prior to placement in the driving leads. Any unusual cracks (cracks other than crazing, surface drying, shrinkage cracks, and end cracks) shall be brought to the attention of the Contracting Officer. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Contracting Officer, shall be rejected and removed from the project site, or may be repaired, if approved, at no cost to the Government.

1.8.1.1 Repairable Cracks

Piles with cracks equal to or greater than 0.15 mm but less than 1.5 mm shall be rejected or repaired. As an alternate to pile rejection, the Contractor may submit a proposal to repair deficient piles, which shall be restored prior to driving to provide its required design capacity, perform its intended function in the structure, and take into consideration long term durability in corrosive environment.

1.8.1.2 Non-Repairable Cracks

Piles with cracks equal to or greater than 1.5 mm shall be rejected.

1.8.2 Pile Sweep

Sweep shall be limited to 3 mm per 3 M over the length of the pile. Piles having excessive sweep shall be rejected.

PART 2 PRODUCTS

2.1 MATERIALS

Materials used for manufacturing precast/prestressed concrete piles shall comply with JIS A 5373.

2.2 CONCRETE MIX DESIGN

Concrete shall have a minimum compressive strength of 80 MPa at 28 days and a maximum size aggregate of [_____] mm. Concrete shall be air entrained with a minimum of 4.5 percent and a maximum of 7.5 percent. Mix shall contain fly ash, ground iron blast furnace slag or silica fume to meet the requirements specified herein to mitigate Alkali-Silica Reactivity (ASR). For marine exposure, ensure a dense concrete free of shrinkage cracks, with a minimum degree of permeability. The maximum water cement ratio shall be 0.40.
2.3  FABRICATION

2.3.1  Formwork

Formwork and dimensional tolerances shall be in accordance with JIS A 5373, and as specified herein. Provide forms of metal, braced and stiffened against deformation, accurately constructed, watertight, and supported on unyielding casting beds. Forms shall permit movement of pile without damage during release of prestressing force. Form precast dowel holes with galvanized flexible metal conduit. [Inside forms or void tubes not to be grouted may be treated cardboard, plywood, or other material.]

2.3.2  Pretensioning

Pretensioning shall be performed in accordance with JIS A 5373, and as specified herein. Use gage calibrated within last 6 months by a laboratory approved by Contracting Officer. Provide means for measuring elongation of steel to nearest 3 mm. Give tensioning steel a uniform prestress prior to being brought to design prestress. Induce same initial prestress in each unit when several units of prestressing steel in a pile are stretched simultaneously.

2.3.3  Casting

2.3.3.1  Conveying

Convey concrete to formwork in accordance with JIS A 5373, and as specified herein. Clean conveying equipment thoroughly before each run. During placing, make any free vertical drop of the concrete less than 0.91 m. Remove concrete which has segregated in conveying or placing.

2.3.3.2  Placing and Casting

Perform concrete casting within 3 days after pretensioning steel; however, do not deposit concrete in forms until placement of reinforcement and anchorages has been inspected and approved by pile manufacturer's quality control representative. Produce each pile of dense concrete straight with smooth surfaces with reinforcement retained in its proper position during fabrication. Use vibrator with heads smaller than the minimum distance between steel for pretensioning. Make surface of pile ends perpendicular to axis of pile. Chamfer, [a minimum of 19 mm,] [[_____] mm,] [between 19 mm and 31 mm,] ends of piles and corners of square piles.

2.3.4  Curing of Piles

Cure piles using moist or accelerated curing. Curing of piles shall be in accordance with JIS A 5373 except as follows.

2.4  PRODUCT QUALITY CONTROL

Where piling is manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control" perform product quality control in accordance with JIS A 5373. Where piling is manufactured by specialists or in plants not currently enrolled in the PCI "Certification Program for Quality Control," set-up a product quality control system in accordance with JIS A 5373 and perform concrete and aggregate quality control testing using an independent commercial testing laboratory approved by the Contracting Officer in accordance with the following.
2.4.1 Aggregate Tests

Aggregate tests shall comply with JIS A 5373.

2.4.2 Slump and Strength Tests

Slump and compressive strength tests shall comply with JIS A 5373.

2.4.3 Changes in Proportions

If, after evaluation of strength test results, compressive strength is less than specified compressive strength, make adjustments in proportions and water content and changes in temperature, moisture, and curing procedures as necessary to secure specified strength. Submit changes in mix design to Contracting Officer in writing.

PART 3 EXECUTION

3.1 PILE DRIVING EQUIPMENT

3.1.1 Pile Hammers

Furnish a hammer capable of developing the indicated ultimate pile capacity considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material to be encountered. [Use the same pile hammer, operating at the same rate and in the same manner, as that used for driving test piles.] Obtain required driving energy of hammer, except for diesel hammers, by use of a heavy ram and a short stroke with low impact velocity. At final driving, operate pile hammer in accordance with manufacturer's recommendation for driving either end bearing piles or friction piles. At final driving, operate diesel powered hammers at rate recommended by manufacturer for hard driving. Maintain pressure at steam or air hammer so that: (1) for double-acting hammer, the number of blows per minute during and at completion of driving of a pile is equal approximately to that at which hammer is rated; (2) for single-acting hammer, there is a full upward stroke of the ram; and (3) for differential type hammer, there is a slight rise of hammer base during each upward stroke.

3.1.2 Driving Helmets and Cushion Blocks

3.1.2.1 Driving Helmets or Caps and Pile Cushions

Use a steel driving helmet or cap including a pile cushion between top of pile and driving helmet or cap to prevent impact damage to pile. Use a driving helmet or cap and pile cushion combination capable of protecting pile head, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly over top of pile. Provide driving helmet or cap that fits sufficiently loose around top of pile so that pile may be free to rotate without binding within driving helmet. [During test pile installation, demonstrate to satisfaction of Contracting Officer that equipment to be used on project performs specified function.] Use pile cushion of solid wood or of laminated construction using plywood, softwood or hardwood boards with grain parallel to end of pile. Provide pile cushion with thickness of [_____] [75] mm minimum and the thickness shall be increased so as to be suitable for the size and length of pile, character of the sub-surface material to be encountered, hammer
characteristics, and the required driving resistance. Replace pile cushion at the start of driving of each pile and when it becomes highly compressed, charred or burned, or has become spongy or deteriorated in any manner. Show details of driving helmets, capblocks, and pile cushions. Submit 2 weeks prior to [test] pile installation.

3.1.2.2 Hammer Cushion or Capblock

Use a hammer cushion or capblock between driving helmet or cap and hammer ram consisting of [a solid hardwood block with grain parallel to the pile axis and enclosed in a close-fitting steel housing] [aluminum and micarta (or equal) discs stacked alternately in a steel housing or a suitable polymer designed for this specific purpose as indicated by the hammer manufacturer]. Use steel plates at top and bottom of capblock. [Replace wood capblock when it becomes highly compressed, charred or burned or becomes spongy or deteriorated in any manner]. [Replace aluminum, micarta or polymer discs that have become damaged, split or deteriorated in any manner]. [Do not replace wood capblock during final driving of any pile.] Do not use small wood blocks, wood chips, rope or other materials that permit excessive loss of hammer energy.

3.2 PRELIMINARY WORK

[3.2.1 Wave Equation Analysis of Pile Drivability

a. Prior to driving any pile, the Contractor shall submit a pile Wave Equation Analysis, performed by his Geotechnical Consultant, for each size pile and distinct subsurface profile condition. These analyses shall take into account the proposed hammer assembly, pile cap block and cushion characteristics, the pile properties and estimated lengths and the soil properties anticipated to be encountered throughout the installed pile length based on static capacity analysis with consideration of driving gain/loss factors. Only one specific model of pile hammer may be used for each pile type and capacity.

b. The Wave Equation Analysis shall demonstrate that the piles will not be damaged during driving, shall indicate that the driving stresses will be maintained within the limits below and indicate the blow count necessary to achieve the required ultimate static pile capacities.

Allowable Driving Stresses

Steel Piles

Compression - 0.9 fy (MPa)
Tension - 0.9 fy (MPa)

Where fy is yield strength of steel

Concrete

Compression - 0.85f'c minus UPL (MPa)
Tension - (0.25 times (the square root of f'c)) plus UPL (MPa)

f'c is compressive strength of concrete (MPa)
UPL = Unit Prestress after Losses (MPa)
(Obtain values from pile manufacturer)
c. Upon completion of the dynamic and static testing programs outlined in this specification section, a refined Wave Equation Analysis shall be performed taking into consideration the evaluated capacities, gain/loss factors and recommended production pile lengths. Production pile driving criteria shall be developed based on the results of the refined Wave Equation Evaluations.

d. All pile driving equipment furnished by the Contractor shall be subject to the approval of the Contractor's Geotechnical Consultant. Complete the attached pile and driving equipment data form, including hammer information, in full as part of the submittal of the results of the Wave Equation Analyses.

e. The cost of performing the Wave Equation Analyses shall be paid for by the Contractor and included in the base bid.

]3.2.2 Order List

The Contractor shall submit to the Contracting Officer for approval, an itemized list for piles prior to placing the order with the supplier. The list shall indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile. [Load testing and refined wave equation analysis shall be completed prior to submission of an order list.]

3.2.3 Pile Length Markings

The Contractor shall mark each pile prior to driving with horizontal lines at 1 m intervals, and the number of feet from pile tip at 1 m intervals.

3.3 PILE DRIVING

3.3.1 Driving Piles

Notify Contracting Officer 10 days prior to driving of [test] piles [and load test]. [Foundation excavation shall be stopped at 300 mm above foundation grade before piles are driven. When pile driving is completed, excavation shall be completed to lines and grade shown.] Piles may be driven when the specified 28-day concrete strength has been achieved but not less than 7 days after casting. Drive piles to [or below "calculated"] [indicated] tip elevation [to reach a driving resistance established by the wave equation analyses (WEAP) in accordance with the schedule which the Government Contractor's Geotechnical Consultant will prepare from the test-pile driving data]. During initial driving and until pile tip has penetrated beyond layers of very soft soil [or below bottom of predrilled or prejetted holes], use a reduced driving energy of the hammer as required to prevent pile damage. Refusal criteria shall be established by the Contracting Officer. If a pile fails to reach ["calculated"] [indicated] tip elevation, [or if a pile reaches ["calculated"] tip elevation without reaching required driving resistance,] notify Contracting Officer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB. Piles or pile sections shall not be handled or moved in any manner that would result in cracking or permanent damage to the concrete or to the grout surrounding the prestressing cables. Piles may be driven without pile guides or leads providing a hammer guide frame is used to keep the pile and hammer in alignment.
3.3.2 Protection of Piles

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in leads. Where pile or projecting reinforcement orientation is essential, take precautionary measures to maintain the orientation during driving. [Take special care in supporting battered piles to prevent excessive bending stresses in pile.] Square top of pile to longitudinal axis of pile. Maintain axial alignment of pile hammer with that of the pile. If the Contractor elects to use a pile head with projecting strands or mild steel reinforcement, prevent direct impact forces from being transmitted through the reinforcement, by using a special driving head.

3.3.3 Tolerances in Driving

Drive piles with a variation of not more than 2 percent from vertical for plumb piles or more than 4 percent from required angle for batter piles. Maintain and check axial alignment of pile and leads at all times. If subsurface conditions cause pile drifting beyond allowable axial alignment tolerance, notify Contracting Officer and perform corrective measures as directed. Place butts within 100 mm of location indicated. Manipulation of piles within specified tolerances will not be permitted. Manipulation of piles within specified tolerances will be permitted, to a maximum of 1 1/2-percent of their exposed length above ground surface or mudline.) In addition to specified tolerances, maintain a location to provide a clear distance of at least 125 mm from butt to edge of pile cap. If clear distance can not be maintained, then notify Contracting Officer. Check each pile for heave. Redrive heaved piles to required point elevation.

3.3.4 Rejected Piles

Piles damaged or impaired for use during handling or driving, mislocated, or driven out of alignment beyond the maximum tolerance shall be withdrawn and replaced by new piles or shall be cut-off and abandoned and new piles driven as directed. Excess cut-off from piles and unacceptable piles shall be removed from the work site. All work in connection with withdrawing and removing rejected piles from the site shall be done at no additional cost to the Government.

3.3.5 Jetting of Piles

Water jets will not be permitted. Jetting may shall be used to assist driving piles through strata that cannot be penetrated practicably by use of the hammer alone. Driving shall be restricted to a static weight while water is being injected to prevent inducing tensile stresses in the piles which damage the concrete. After the penetration of the strata requiring jetting has been accomplished, jetting shall be discontinued and hammer driving shall be resumed. Discontinue jetting when the pile tip is approximately 1.5 m above the calculated indicated pile tip elevation. Drive pile the final 1.5 m of penetration. Adequate measures shall be taken for collecting and disposing of runoff water. Jetting method and equipment shall be approved by the Contracting Officer prior to commencing jetting operation. Before starting final driving, firmly seat piles in place by application of a number of reduced energy hammer blows. Measures, including use of a silt curtain, shall be employed to contain turbid water created by jetting piles.
3.3.6 Predrilling of Piles

Predrilling to remove soil or other material representing the bulk of the volume of the pile to be driven[ will not be permitted][ shall be provided]. [The diameter of the hole should not exceed two-thirds the width of the pile.][Predrill only to a depth of [_____] meters below cut-off elevation prior to setting piles.][Discontinue drilling when the pile tip is approximately 1.5 m above the [calculated] [indicated] pile tip elevation. Drive pile the final 1.5 m of penetration.]

3.3.7 Splices

[ Splicing of piles is not permitted.][Make splices as indicated. Splices shall be capable of developing the full strength of the member in compression, tension, shear, and bending. Detail drawings of splices and design calculations demonstrating the strength of the splice shall be submitted for approval.]

3.3.8 Build-Ups

Where required, pile section may be extended to cut-off elevation by means of a cast-in-place reinforced concrete build-up or by adding a new pile segment with same properties of the below pile. Make build-up in accordance with JIS A 5373. Construct build-ups made after completion of driving in accordance with detail, "Build-Up Without Driving." Make build-ups to be driven in accordance with detail "Build-Up With Driving." Have details of means for protecting joints by a suitable mortar or epoxy approved by Contracting Officer. Where build-ups are exposed to water, protect cast-in-place section from water during curing period. Concrete in build-up shall have a minimum compressive strength of [_____] MPa. Build-ups will not be permitted on more than [_____] percent of total number of piles. If this percent figure is exceeded, or if in the judgment of the Contracting Officer, the clustered location of build-ups is undesirable, withdraw piles of insufficient length and replace with longer piles. Payment for such withdrawal and replacement will be made as an adjustment to the contract price.

3.3.9 Pile Cut-Off

Cut-off piles with a smooth level cut using pneumatic tools, sawing, or other suitable methods approved by Contracting Officer. Use of explosives for cutting is not permitted. Cut-off sections of piles shall be removed from the site upon completion of the work.

3.4 FIELD QUALITY CONTROL

3.4.1 Test Piles

[ Use test piles of type, and drive as specified for piling elsewhere in this section. ][Order test piles [_____] meters longer in length than production piles. The additional test pile length shall be driven only at the direction of the Contracting Officer. ][The Contractor's Geotechnical Consultant will use test pile data to determine "calculated" pile tip elevation or necessary driving resistance. Drive test piles [at the locations indicated] [in vicinity of soil boring test holes Nos. [_____,] [_______,] and [_______]]. Drive test piles to [indicated tip elevation] [indicated bidding lengths]. Use test piles, if located properly and offering adequate driving resistance in finished work. [Pre-drilling or jetting is permitted only when test piles clearly establish validity of its]
use, or as directed by the Contracting Officer.  

A pile dynamic analyzer shall be provided and operated as specified in paragraph DYNAMIC PILE ANALYSIS during the driving of each test pile.  Modify driving as required based upon recommendation of Contractor's Geotechnical Consultant and approval of the Contracting Officer.

3.4.2 Dynamic Pile Analysis

The purpose of dynamic testing is to provide supplemental information for evaluating pile hammer performance, driving stresses, and bearing capacities.  Dynamic testing shall be conducted during the entire time piles are initially driven or redriven and during pile restrike testing.  Use test piles of type as specified elsewhere in this section.  Equipment to obtain dynamic measurements, record, reduce and display its data shall be furnished and meet the requirement of JGS 1816.  The equipment shall have been calibrated within 12 months thereafter throughout the contract duration.  Drive test piles at the locations indicated.  The contractor shall employ an independent inspection firm, hereinafter referred to as the "Contractor's Geotechnical Consultant", experienced in the pile driving process, monitoring of test pile installation, and in the use of the Pile Driving Analyzer and its related equipment.  Dynamic pile analysis shall be performed as follows:

a. Each dynamic pile analysis shall be performed in two steps.  The first step is to check the hammer, pile and soil performance, and to determine the suitability of the proposed hammer for the size, length and type of pile being installed for the soil types encountered as the piles are driven.  This initial monitoring shall determine whether pre-augering or jetting is appropriate, efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile and extent/location of any pile damage caused by the initial driving.  With each blow of the pile the information listed below shall be electronically recorded and analyzed by the Pile Driving Analyzer:

(1) Blow number
(2) Blow rate per minute and/or stroke.
(3) Input and reflected values of force and velocity.
(4) Value of upward and downward traveling force wave with time.
(5) Maximum and final transferred energy to pile, hammer system efficiency.
(6) Maximum compressive stress, velocity, acceleration and displacement.
(7) Maximum tensile stress in pile.
(8) Pile structural integrity, damage detection, extent and location.
(9) Bearing capacity of pile by Case method.

If the pile, hammer and soil performance evaluation recommends changes to the hammer stroke, pile cushioning, augering or any other aspect for the pile driving operation these changes shall be
incorporated into production pile driving in an effort to control excessive stresses and pile damage. Test piles damaged or broken during installation shall be replaced, incorporating driving modifications as determined by the Contractor's Geotechnical Consultant and reviewed and approved by the Contracting Officer. This procedure shall be repeated until allowable tensile and compressive stresses are achieved in the pile and/or pile damage is minimized. Selected initial driving records shall be subjected to rigorous computer analysis based on the Case Method for determination of resistance distribution, soil resistance and properties, and estimation of anticipated gain/loss factors.

b. Upon completion of test pile driving the piles shall be allowed to set-up for at least 72 hours. After evaluation of pile, hammer and soil performance by the Contractor's Geotechnical Consultant, the second step of the dynamic pile analysis may proceed. This portion of the evaluation requires striking the set-up piles a minimum of 20-50 times, or as directed by the Contractor's Geotechnical Consultant using the same hammer which was used for the test pile driving and which will be used for production pile driving. The hammer shall be "warmed up" and in optimal readiness prior to restriking, in order to avoid capacity losses during evaluation of restrike data. Maximum hammer energy shall be applied during restrike in order to fully mobilize the soil resistance. However, care should be exercised as not to overstress the pile. In addition to those items listed above, selected restrike driving records (as directed by the Contractor's Geotechnical Consultant) are to be subjected to rigorous computer analysis based on the Case method for determination of resistance distribution, soil resistance and properties, and plot of applied load vs. average pile displacement based on the calculated soil properties.

c. Performance Report:

(1) Upon satisfactory completion of each dynamic load test a minimum of three copies of a Pile Performance Report shall be submitted for the Contractor by the Contractor's Geotechnical Consultant. The submittal shall be prepared and sealed by a Professional Engineer registered in any jurisdiction of the U.S. or its territories or Japan and shall be made within three working days of the completion of the dynamic load test.

(2) The report for the Dynamic Pile Analysis shall contain the following information:

(a) Bearing capacity of pile. Information resulting from analysis of a selected restrike blow.

(b) Maximum and final transferred energy, hammer system efficiency during pile installation.

(c) Maximum compressive stress, velocity, acceleration and displacement.

(d) Maximum tensile stress in pile.

(e) Pile structural integrity, damage detection, extent and location.

(f) Blows per minute and blow number.
(g) Input and reflection values of force and velocity, upward and downward traveling force wave with time.

(h) Pile skin friction and toe resistance distribution.

(i) Maximum energy transferred to pile.

(3) The maximum allowable pile design load will be proposed by the Contractor's Geotechnical Consultant based upon the results of a satisfactory pile load test conducted on a pile driven as specified herein and shall include the effects of load transfer to the soil above the foundation stratum.

d. The equipment to be used for dynamic testing of the pile hammer and soil performance and for dynamic load testing of the test pile shall meet the requirements of JGS 1816.

e. All services of the Contractor's Geotechnical Consultant shall be paid for by the Contractor. The Contractor's Geotechnical Consultant shall be available throughout the pile driving operation to consult with the Contracting Officer when required by the Contracting Officer. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Driving Analysis, shall be at the Contractor's expense.

3.4.3 Static Load Tests

Perform compressive load tests on [_____] test piles in accordance with JGS 1811 as modified herein. [Allow a minimum of 72 hours following final test pile driving for pile set-up prior to load testing. ][Do not use anchor piles.] Provide apparatus for applying vertical loads as required by method, using load from weighted box or platform [or reaction frame attached to sufficient uplift piles to safely take required load] applied to pile by hydraulic jack. Increase load in increments until rapid progressive settlement takes place or until application of total compressive load of [_____] metric tons for compressive load tests. Consider load test satisfactory when [after one hour at full test load gross settlement of pile butt is not greater than gross elastic pile compression plus 4 mm plus one percent of pile tip diameter or width in [_____] mm,] [slope of gross load-settlement curve under full test load does not exceed 1.5 mm per metric ton,] [net settlement after removal of test load does not exceed 19 mm.] Perform load tests at locations[ as proposed by the Contractor's Geotechnical Consultant and] as directed by the Contracting Officer. Additional load tests, at Government expense, may be required by the Contracting Officer. Loading, testing, and recording and analysis of data shall be under the direct supervision of a Registered Professional Engineer, registered in the state of project location, and provided and paid for by the Contractor.

3.4.3.1 Safe Design Capacity

The safe design capacity of a test pile as determined from the results of load tests shall be the lesser of the two values computed according to the following:

a. One-half of that load which causes a net settlement after rebound of not more than 0.28 mm per metric ton of total test load.
b. One-half of the load that causes a gross settlement of not more than 25 mm, provided the load settlement curve shows no sign of failure.

[3.4.4 Tensile Load Test]
Perform tensile load tests on [_____] test piles in accordance with JGS 1813, as modified [and] in paragraph LOAD TESTS. A tensile load of [_____] kN shall be applied to each tensile load test pile. In performing the tension load test, the ultimate load to be applied shall be one and one-half times the safe tension capacity, and the Standard Loading Procedure shall be employed.

[3.4.5 Lateral Load Test]
Perform lateral load tests on [_____] piles in accordance with JGS 1831, as modified [and] in paragraph LOAD TESTS. Lateral load tests shall consist of jacking two piles apart with a hydraulic jack, with one pile serving as the reaction pile for the other. A lateral load of [_____] kN shall be applied to each pair of lateral load test piles. Required movement readings shall be made and recorded for each pile.

[3.4.6 Pile Records]
Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, [batter alignment,] number of blows required for each 300 mm of penetration and number of blows for the last 150 mm penetration or fraction thereof [as required] for the "calculated" [driving resistance]. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, obstructions, [jetting,] and any driving interruptions. A preprinted pile driving log for recording pile driving data[ and pile driving equipment data form], which can be downloaded at: http://www.wbdg.org/FFC/NAVGRAPH/graphtoc.pdf. For piles installed by the Cement-Milk Method, provide the actual grout amount pumped into the predrilled hole on the Pile Record.

[3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS]
Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

[3.6 PILE INSTALLATION BY PLACING METHODS ("Cement-Milk" Method)]
Pile installation by placing methods consists of pre-drilling with earth auger system and filling with cement grout ("cement milk").

If required, use borehole stabilizing liquid during pre-drilling operations. Excavation liquid shall be Bentonite plus cement plus water with following standard mixing quantities
### Bentonite (kg) | Cement (kg) | Water (l)
---|---|---
25 - 50 | 80 - 160 | 450 - 500

The cement milk compressive strength at 28-Days shall be greater than 20 MPa. The cement milk mix design that can provide the required compressive strength shall be submitted before concrete is placed. Piles shall be open-end piles.

#### 3.6.1 PILE INSTALLATION PROCEDURES

1. Conduct pre-drilling operations as indicated in drawings.
2. Earth auger head diameter is approximately pile diameter plus 100 mm.
3. The electric current of earth auger motor shall be recorded continuously.
4. Drilling and Pile Erection
   
   (a) Perform drilling in a vertical direction aligned with the pile centerline and prevent soil on the lateral surface of a borehole from collapsing by using soil stabilizing liquid. Do not rotate the earth auger in a reverse direction when it is pulled out.
   
   (b) After the earth auger reaches the specified bearing ground and subsequently cement milk for condensation is injected, pull out the earth auger while injecting perimeter condensation liquid, place a pile into the borehole while being careful of not damaging the lateral surface of the borehole, either applying pressure with the pile equipment or by slightly driving the pile with a hammer.
   
   (c) After placing the pile into the borehole, allow for curing process for approximate 7 days while keeping it as it is aligned with the pile centerline.
5. Stabilizing Liquid, Cement Milk for Condensation, and Perimeter Condensation Liquid
   
   (a) Use borehole stabilizing liquid for preventing the lateral surface of a borehole from collapsing.
   
   (b) Cement milk for condensation is a cement-grout material that is injected at the pile top zone.
   
   (c) Perimeter condensation liquid is a cement-grout material injected to fill the gap between the pile and the borehole.
6. Perform supervision tests for cement milk for condensation and perimeter condensation liquid as follows:
   
   (a) The number of samples per test shall be three.
   
   (b) Collect samples as follows: 1) Collect the amount of cement milk for condensation for one test from a grout plant at one time. 2) Collect the amount of perimeter condensation liquid from the cement milk flown over a drilled hole at one time after inserting a pile into it.
   
   (c) Collect samples by using polyethylene bags and make cylindrical
samples with the approximate diameter of 50 mm and the approximate height of 100 mm.

(d) Cure samples in accordance with the standard cure method which is in the water curing at 20+2 degrees C specified in JIS A 1132.

(e) Strength test shall be in accordance with JIS A 1108 (Method of Test for Compressive Strength of Concrete).

(f) The compressive strengths of cement milk for condensation and perimeter condensation liquid are those determined on the 28th day of curing. Required compressive strengths are listed below.

Compressive Strength (Unit: N/mm²)

<table>
<thead>
<tr>
<th>Type</th>
<th>Compressive Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Milk for Condensation</td>
<td>20 or greater</td>
</tr>
<tr>
<td>Perimeter Condensation Liquid</td>
<td>0.5 or greater</td>
</tr>
</tbody>
</table>

3.6.2 FIELD QUALITY CONTROL

Tests indicated in Section 3.4.2, 3.4.3, 3.4.4 and 3.4.5 may also be applicable to piles installed by the "cement-milk" method.

3.6.3 ENVIRONMENTAL CONSIDERATIONS

The Soil Mixing Contractor shall use cement materials in order to comply with the regulations from the Japanese Ministry of the Environment indicated in Notification No.46 (i.e. limits for Hexavalent Chromium Leachate in Soils) or other applicable local environmental regulations.

-- End of Section --
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SECTION 32 01 16.71

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   1.1.3 Traffic Control

1.2 EQUIPMENT, TOOLS, AND MACHINES
   1.2.1 Cold-Milling Machine
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SECTION 32 01 16.71

COLD MILLING ASPHALT PAVING

02/17

PART 1   GENERAL

1.1  QUALITY ASSURANCE

1.1.1  Grade

Mill pavement such that the finished surface conforms to the lines, grades, and cross sections indicated. The maximum allowable deviation of the finished milled pavement surfaces from the established plan grade line and elevation will be 6 mm. The deviations from the plan grade line and elevation will not be permitted in areas of pavements where closer conformance with planned grade and elevation is required for the proper functioning of appurtenant structures involved.

1.1.2  Surface Smoothness

The maximum allowable deviation of the finished surfaces from the testing edge in the transverse or longitudinal direction will be 6 mm.

1.1.3  Traffic Control

Provide all necessary traffic controls during milling operations.

1.2  EQUIPMENT, TOOLS, AND MACHINES

Maintain in a satisfactory working condition equipment, tools, and machines used in the performance of the work.

1.2.1  Cold-Milling Machine

Provide a cold-milling machine which is self-propelled, capable of milling the pavement to a specified depth and smoothness and of establishing grade control; with means of controlling transverse slope and dust produced during the pavement milling operation. Machine will have capability of adding water in front of equipment to minimize dust during milling operation. The machine will have the ability to remove the millings or cuttings from the pavement and load them into a truck. The milling machine will not damage any part of the pavement structure that is not to be removed.

1.2.2  Cleaning Equipment

Provide cleaning equipment suitable for removing and cleaning loose material from the pavement surface.

1.2.3  Straightedge

Furnish and maintain at the site, in good condition, one 3.66 meter straightedge or other suitable device for each milling machine, for testing the finished surface. Make straightedge available for Government use. Use straightedges constructed of aluminum or other lightweight metal, with
blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Use straightedges with handles to facilitate movement on the pavement.

1.3 ENVIRONMENTAL REQUIREMENTS

Do not perform milling when there is accumulation of snow or ice on the pavement surface.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 MILLING OPERATION

A minimum of seven days notice is required, prior to start work, for the Contracting Officer to coordinate the milling operation with other activities at the site. Make sufficient passes so that the designated area is milled to the grades and cross sections indicated. Mill the pavement in depth increments that will not damage the pavement below the designated finished grade. If scabbing occurs, the surface will not meet smoothness requirements. Take steps to modify the process as needed to prevent scabbing from occurring. Repair or replace, as directed, items damaged during milling such as manholes, valve boxes, utility lines, pavement that is torn, cracked, gouged, broken, or undercut. Remove the milled material from the pavement and load into trucks.

3.2 GRADE AND SURFACE-SMOOTHNESS TESTING

3.2.1 Grade-Conformance Tests

Test the finished milled surface of the pavement for conformance with the plan-grade requirements and for acceptance by the Contracting Officer by running lines of levels at intervals of 7.5 meters longitudinally and 7.5 meters transversely to determine the elevation of the completed pavement. Correct variations from the designated grade line and elevation in excess of the plan-grade requirements as directed. Skin patching for correcting low areas will not be permitted. Remove and replace the deficient low area. Remove sufficient material to allow at least 25 mm of asphalt concrete to be placed.

3.2.2 Surface-Smoothness Tests

After completion of the final milling, the finished milled surface will be tested by the Government with a straightedge. Other approved devices may be used, provided that when satisfactorily and properly operated, such devices reveal all surface irregularities exceeding the tolerances specified. Correct surface irregularities that depart from the testing edge by more than 6 mm. Skin patching for correcting low areas will not be permitted. Remove and replace the deficient low area. Remove sufficient material to allow at least 25 mm of asphalt concrete to be placed.

3.3 REMOVAL OF MILLED MATERIAL

Stockpile material that is removed as specified and in such a manner to prevent segregation or contamination. Material that is removed will become the property of the Contractor and removed from the site.
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**BASE COURSE FOR RIGID AND SUBBASES FOR FLEXIBLE PAVING**

### 08/17

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SECTION 32 11 20

BASE COURSE FOR RIGID AND SUBBASES FOR FLEXIBLE PAVING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1102 (2014) Method of Test for Sieve Analysis of Aggregates

JIS A 1103 (2014) Method of Test for Amount of Material Passing Test Sieve 75 µm in Aggregates


JIS A 1210 (2009) Test Method for Soil Compaction Using a Rammer


JIS A 5001 (2008) Crushed Stone for Road Construction


JAPANESE GEOTECHNICAL SOCIETY (JGS)


1.2 DEGREE OF COMPACTION

Degree of compaction required is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in JIS A 1210 abbreviated as a percent of laboratory maximum dry density.
1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
   Plant, Equipment, and Tools

SD-06 Test Reports
   Initial Tests; G
   In-Place Tests; G

1.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Use equipment capable of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved in accordance with Section 01 45 00.00 1001 45 00.00 2001 45 00.00 40 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with JIS A 1201. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Perform sieve analysis in conformance with JIS A 1103 and JIS A 1102 using sieves conforming to JIS Z 8801.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with JIS A 1205.
1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture in accordance with paragraph DEGREE OF COMPACTION.

1.5.2.4 Field Density Tests

Measure field density in accordance with JIS A 1214.

1.5.2.5 Wear Test

Perform wear tests on subbase course and or rigid pavement base course material in conformance with JIS A 1121.

1.5.2.6 Weight of Slag

Determine weight per cubic meter of slag in accordance with JIS A 1104.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 2 degrees C. When the temperature falls below 2 degrees C, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Flexible Paving Subbase Course

Provide aggregates conforming to JIS A 5001, C-30/RC-30 and C-40/RC-40 consisting of crushed stone or slag, gravel, shell, sand, or other sound, durable, approved materials processed and blended or naturally combined. Provide aggregates which are free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. The percentage of loss of material retained on the 4.75 mm sieve must not exceed 50 percent after 500 revolutions when tested in accordance with JIS A 1121. Provide aggregate that is reasonably uniform in density and quality. Provide slag that is an air-cooled, blast-furnace product having a dry weight of not less than 1050 kg/cubic meter. Provide aggregates with a maximum size of 37.5 mm for C-40/RC-40 and 31.5 mm for C-30/RC-30 and within the limits specified as follows:
The portion of any blended component and of the completed course passing the 0.425 mm must be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.1.2 Rigid Pavement Base Course

Provide aggregates for rigid pavement base course as specified for flexible paving subbase course.

2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

2.2.1 Initial Tests

Perform one of each of the following tests on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation. Complete this testing for each source if materials from more than one source are proposed.

a. Sieve Analysis.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

e. Weight per cubic meter of Slag.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

### Maximum Allowable Percentage by Weight

**Passing Square-Mesh Sieve**

<table>
<thead>
<tr>
<th>Sieve Designation (mm)</th>
<th>C-30 / RC-30</th>
<th>C-40 / RC-40</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.0</td>
<td>----</td>
<td>100</td>
</tr>
<tr>
<td>37.5</td>
<td>100</td>
<td>95-100</td>
</tr>
<tr>
<td>31.5</td>
<td>95-100</td>
<td>----</td>
</tr>
<tr>
<td>26.5</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>19</td>
<td>55-85</td>
<td>50-80</td>
</tr>
<tr>
<td>13.2</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>4.75</td>
<td>15-45</td>
<td>15-40</td>
</tr>
<tr>
<td>2.36</td>
<td>5-30</td>
<td>5-25</td>
</tr>
</tbody>
</table>
2.2.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area.

3.2 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Stockpile aggregates on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Stockpile materials obtained from different sources separately.

3.3 PREPARATION OF UNDERLYING COURSE OR SUBGRADE

Clean the underlying course or subgrade of all foreign substances prior to constructing the subbase or rigid pavement base course. Do not construct subbase or rigid pavement base course on underlying course or subgrade that is frozen. Construct the surface of the underlying course or subgrade to meet specified compaction and surface tolerances. Correct ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the specified requirements set forth herein by loosening and removing soft or unsatisfactory material and adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in JGS 0051, stabilize the surface prior to placement of the overlying course. Stabilize by mixing the overlying course material into the underlying course and compacting by approved methods. Consider the stabilized material as part of the underlying course and meet all requirements of the underlying course. Do not allow traffic or other operations to disturb the finished underlying course and maintain in a satisfactory condition until the overlying course is placed.

3.4 GRADE CONTROL

Provide a finished and completed subbase and rigid pavement base courses conforming to the lines, grades, and cross sections shown. Place line and grade stakes as necessary for control.

3.5 MIXING AND PLACING MATERIALS

Mix and place the materials to obtain uniformity of the material at the water content specified. Make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.6 LAYER THICKNESS

Compact the completed course to the thickness indicated. No individual layer may be thicker than 150 mm nor be thinner than 75 mm in compacted
thickness. Compact the course(s) to a total thickness that is within 13 mm of the thickness indicated. Where the measured thickness is more than 13 mm deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 13 mm thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 6 mm of the thickness indicated. Measure the total thickness of the course(s) at intervals of one measurement for each 500 square meters of completed course. Measure total thickness using 75 mm diameter test holes penetrating the completed course.

3.7 COMPACTION

Compact each layer of the material, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Slightly vary the length of alternate trips of the roller. Adjust speed of the roller as needed so that displacement of the aggregate does not occur. Compact mixture with hand-operated power tampers in all places not accessible to the rollers. Continue compaction of the subbase until each layer is compacted through the full depth to at least 100 percent of laboratory maximum density. Continue compaction of the rigid base course until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. Make such adjustments in compacting or finishing procedures as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase and rigid pavement base course. Remove any materials that are found to be unsatisfactory and replace with satisfactory material or rework, as directed, to meet the requirements of this specification.

3.8 PROOF ROLLING

In addition to the compaction specified, proof roll subbase course under a flexible airfield pavement in areas designated on the drawings by application of 30 coverages for Class IV runways, 8 coverages for runways that support fighter aircraft only, and 4 coverages to all other paved areas, of a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 13,600 kg and inflated to a minimum of 862 kPa. A coverage is defined as the application of one tire print over the designated area. In the areas designated, apply proof rolling to the top layer of the completed subbase course. Maintain water content of the top layer of the subbase course as specified in paragraph COMPACTION from start of compaction to completion of proof rolling. Remove any subbase course materials that produce unsatisfactory results by proof rolling and replace with satisfactory materials. Then recompact and proof roll to meet specifications.

3.9 EDGES OF SUBBASE AND RIGID PAVEMENT BASE COURSE

Place approved material along the outer edges of the subbase and rigid pavement base course in sufficient quantity to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, simultaneously roll and compact at least a 600 mm width of this shoulder material with the rolling and compacting of each layer of the
subbase and rigid pavement base course, as directed.

3.10 FINISHING

Finish the surface of the top layer of rigid pavement base course after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Do not add thin layers of material to the top layer of rigid pavement base course to meet grade. If the elevation of the top layer of rigid pavement base course is 13 mm or more below grade, scarify the top layer to a depth of at least 75 mm and blend new material in and compact and proof roll to bring to grade. Make adjustments to rolling and finishing procedures as directed by the Contracting Officer to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable rigid pavement base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, scarify the unsatisfactory portion and rework and recompact it or replace as directed.

3.11 SMOOTHNESS TEST

Construct the top layer so that the surface shows no deviations in excess of 10 mm when tested with a 3.00 m straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Also take measurements perpendicular to the centerline at 15 meter intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.12 FIELD QUALITY CONTROL

3.12.1 In-Place Tests

Perform one of each of the following tests on samples taken from the placed and compacted subbase and rigid pavement base course. Take samples and test at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 500 square meters, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 1,000 square meters, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the thickness of each course at intervals providing at least one measurement for each 500 square meters or part thereof. Measure the thickness using test holes, at least 75 mm in diameter through the course.

3.12.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and fully compacted course(s).
3.13 TRAFFIC

Do not allow traffic on the completed subbase and rigid pavement base course for airfield pavements. For roads, do not allow heavy equipment on the completed rigid pavement base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed rigid pavement base course, protect the area against marring or damage to the completed work.

3.14 MAINTENANCE

Maintain the completed course in a satisfactory condition until the full pavement section is completed and accepted. Immediately repair any defects and repeat repairs as often as necessary to keep the area intact. Retest any course that was not paved over prior to the onset of winter to verify that it still complies with the requirements of this specification. Rework or replace any area that is damaged as necessary to comply with this specification.

3.15 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that have been removed as directed. No additional payments will be made for materials that have to be replaced.

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AGGREGATE BASE COURSES

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

- JIS A 1102 (2014) Method of Test for Sieve Analysis of Aggregates
- JIS A 1103 (2014) Method of Test for Amount of Material Passing Test Sieve 75 µm in Aggregates
- JIS A 1112 (2012) Method of Test for Washing Analysis of Fresh Concrete
1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in JIS A 1210 abbreviated as a percent of laboratory maximum dry density.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- SD-03 Product Data
- Plant, Equipment, and Tools
- SD-06 Test Reports
  - Initial Tests; G
  - In-Place Tests; G

1.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Use equipment capable of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform
sampling and testing using a laboratory approved in accordance with Section
01 45 00.00 1001 45 00.00 2001 45 00.00 40 QUALITY CONTROL. Work requiring
testing will not be permitted until the testing laboratory has been
inspected and approved. Test the materials to establish compliance with
the specified requirements and perform testing at the specified frequency.
The Contracting Officer may specify the time and location of the tests.
Furnish copies of test results to the Contracting Officer within 24 hours
of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with JIS A 1201. When
deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Perform sieve analysis in conformance with JIS A 1103 and JIS A 1102 using
sieves conforming to JIS Z 8801.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with JIS A 1205.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content
in accordance with paragraph DEGREE OF COMPACTION.

1.5.2.4 Field Density Tests

Measure field density in accordance with JIS A 1214.

1.5.2.5 Wear Test

Perform wear tests on ABC and GCA course material in conformance with
JIS A 1121.

1.5.2.6 Soundness

Perform soundness tests on GCA in accordance with JIS A 1112.

1.5.2.7 Weight of Slag

Determine weight per cubic meter of slag in accordance with JIS A 1104 on
the ABC and GCA course material.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 2 degrees C.
When the temperature falls below 2 degrees C, protect all completed areas
by approved methods against detrimental effects of freezing. Correct
completed areas damaged by freezing, rainfall, or other weather conditions
to meet specified requirements.
PART 2 PRODUCTS

2.1 AGGREGATES

Provide Aggregate Base Course (ABC) and Graded-Crushed Aggregate (GCA) base course consisting of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. Provide ABC that is free of lumps of clay, organic matter, and other objectionable materials or coatings. Provide GCA that is free of silt and clay as defined by JGS 0051, organic matter, and other objectionable materials or coatings. The portion retained on the 4.75 mm sieve is known as coarse aggregate; that portion passing the 4.75 mm sieve is known as fine aggregate. Base course shall conform to JIS A 5001, M-30/RM-30 and M-40/RM-40. When the coarse and fine aggregate is supplied from more than one source, provide aggregate from each source that meets the specified requirements.

2.1.1 Coarse Aggregate

Provide coarse aggregates with angular particles of uniform density. Separately stockpile coarse aggregate supplied from more than one source.

a. Crushed Gravel: Provide crushed gravel that has been manufactured by crushing gravels and that meets all the requirements specified below.

b. Crushed Stone: Provide crushed stone consisting of freshly mined quarry rock, meeting all the requirements specified below.

c. Crushed Recycled Concrete: Provide crushed recycled concrete consisting of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. Provide recycled concrete that is free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and that has been crushed and processed to meet the required gradations for coarse aggregate. Reject recycled concrete aggregate exceeding this value. Provide crushed recycled concrete that meets all other applicable requirements specified below.

d. Crushed Slag: Provide crushed slag that is an air-cooled blast-furnace product having an air dry unit weight of not less than 1120 kg/cubic meter as determined by JIS A 1104, and meets all the requirements specified below.

2.1.1.1 Aggregate Base Course

The percentage of loss of ABC coarse aggregate must not exceed 50 percent when tested in accordance with JIS A 1121.

2.1.1.2 Graded-Crushed Aggregate Base Course

The percentage of loss of GCA coarse aggregate must not exceed 40 percent loss when tested in accordance with JIS A 1121. Provide GCA coarse aggregate that does not exhibit a loss greater than 18 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate, or 12 percent weighted average, at five cycles, when tested in sodium sulfate in accordance with JIS A 1112.
2.1.2 Fine Aggregate

Provide fine aggregates consisting of angular particles of uniform density.

2.1.2.1 Aggregate Base Course

Provide ABC fine aggregate that consists of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.2.2 Graded-Crushed Aggregate Base Course

Provide GCA fine aggregate consisting of angular particles produced by crushing stone, slag, recycled concrete, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Produce fine aggregate by crushing only particles larger than 4.75 mm sieve in size. Provide fine aggregate that contains at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the 4.75 mm sieve and retained on the 2 mm sieve, and in the portion passing the 2 mm sieve and retained on the 0.425 mm sieve. Manufacture fine aggregate from gravel particles 95 percent of which by weight are retained on the 12.5 mm sieve.

2.1.3 Gradation Requirements

Apply the specified gradation requirements to the completed base course. Provide aggregates that are continuously well graded within the limits specified in TABLE 1. Use sieves that conform to JIS Z 8801.
TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

<table>
<thead>
<tr>
<th>Sieve Designation (mm)</th>
<th>M-30 / RM-30</th>
<th>M-40 / RM-40</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.0</td>
<td>----</td>
<td>100</td>
</tr>
<tr>
<td>37.5</td>
<td>100</td>
<td>95-100</td>
</tr>
<tr>
<td>31.5</td>
<td>95-100</td>
<td>----</td>
</tr>
<tr>
<td>26.5</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>19.0</td>
<td>60-90</td>
<td>60-90</td>
</tr>
<tr>
<td>13.2</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>4.75</td>
<td>30-65</td>
<td>30-65</td>
</tr>
<tr>
<td>2.36</td>
<td>20-50</td>
<td>20-50</td>
</tr>
<tr>
<td>1.18</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>0.425</td>
<td>10-30</td>
<td>10-30</td>
</tr>
<tr>
<td>0.075</td>
<td>2-10</td>
<td>2-10</td>
</tr>
</tbody>
</table>

NOTE 1: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, test the materials in accordance with JIS A 1110 and JIS A 1109 to determine their specific gravities. Correct the percentages passing the various sieves as directed by the Contracting Officer if the specific gravities vary by more than 10 percent.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the 0.425 mm sieve must be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed.

a. Sieve Analysis.

b. Liquid limit and plasticity index.
c. Moisture-density relationship.

d. Wear.

e. Soundness.

f. Weight per cubic meter of Slag.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

2.3.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC or GCA is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area.

3.2 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Stockpile aggregates on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Stockpile materials obtained from different sources separately.

3.3 PREPARATION OF UNDERLYING COURSE OR SUBGRADE

Clean the underlying course or subgrade of all foreign substances prior to constructing the base course(s). Do not construct base course(s) on underlying course or subgrade that is frozen. Construct the surface of the underlying course or subgrade to meet specified compaction and surface tolerances. Correct ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the specified requirements set forth herein by loosening and removing soft or unsatisfactory material and adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in JGS 0051, stabilize the surface prior to placement of the base course(s). Stabilize by mixing ABC or GCA into the underlying course and compacting by approved methods. Consider the stabilized material as part of the underlying course and meet all requirements of the underlying course. Do not allow traffic or other operations to disturb the finished underlying course and maintain in a satisfactory condition until the base course is placed.

3.4 GRADE CONTROL

Provide a finished and completed base course conforming to the lines,
3.5 MIXING AND PLACING MATERIALS

Make adjustments in mixing procedures or in equipment, as directed, to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification. Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. Place the layers so that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, clean the previously constructed layers of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Make adjustments in placing procedures or equipment as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.6 LAYER THICKNESS

Compact the completed base course to the thickness indicated. No individual layer may be thicker than 150 mm nor be thinner than 75 mm in compacted thickness. Compact the base course(s) to a total thickness that is within 13 mm of the thickness indicated. Where the measured thickness is more than 13 mm deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompressing as directed. Where the measured thickness is more than 13 mm thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 6 mm of the thickness indicated. Measure the total thickness of the base course at intervals of one measurement for each 500 square meters of base course. Measure total thickness using 75 mm diameter test holes penetrating the base course.

3.7 COMPACTING

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Slightly vary the length of alternate trips of the roller. Adjust speed of the roller as needed so that displacement of the aggregate does not occur. Compact mixture with hand-operated power tampers in all places not accessible to the rollers. Continue compaction until each layer is compacted through the full depth to at least 100 percent of laboratory maximum density. Make such adjustments in compacting or finishing procedures as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Remove any materials found to be unsatisfactory and replace with satisfactory material or rework, as directed, to meet the requirements of this specification.
3.8  PROOF ROLLING

In addition to the compaction specified, proof roll base course under a flexible airfield pavement in areas designated on the drawings by application of 30 coverages for Class IV runways, 8 coverages for runways that support fighter aircraft only, and 4 coverages to all other paved areas, of a heavy pneumatic-tired roller having four or more tires abreast, each tire loaded to a minimum of 13,600 kg and inflated to a minimum of 862 kPa. A coverage is defined as the application of one tire print over the designated area. In the areas designated, apply proof rolling to the top of the underlying material on which the base course is laid and to the top of each layer of the completed base course. Maintain water content of the underlying material and each layer of the base course as specified in Paragraph COMPACT from start of compaction to completion of proof rolling of that layer. Remove any base course materials or any underlying materials that produce unsatisfactory results by proof rolling and replace with satisfactory materials. Then recompact and proof roll to meet these specifications.

3.9  EDGES OF BASE COURSE

Place the base course(s) so that the completed section will be a minimum of 600 mm wider, on all sides, than the next layer that will be placed above it. Place approved material along the outer edges of the base course in sufficient quantity to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, simultaneously roll and compact at least a 600 mm width of this shoulder material with the rolling and compacting of each layer of the base course, as directed.

3.10  FINISHING

Finish the surface of the top layer of base course after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Do not add thin layers of material to the top layer of base course to meet grade. If the elevation of the top layer of base course is 13 mm or more below grade, scarify the top layer to a depth of at least 75 mm and blend new material in and compact and proof roll to bring to grade. Make adjustments to rolling and finishing procedures as directed by the Contracting Officer to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, scarify the unsatisfactory portion and rework and recompact it or replace as directed.

3.11  SMOOTHNESS TEST

Construct the top layer so that the surface shows no deviations in excess of 10 mm when tested with a 3.00 meter straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Also take measurements perpendicular to the centerline at 15 meter intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.
3.12 FIELD QUALITY CONTROL

3.12.1 In-Place Tests

Perform each of the following tests on samples taken from the placed and compacted ABC and GCA. Take samples and test at the rates indicated. Perform sampling and testing of recycled concrete aggregate at twice the specified frequency until the material uniformity is established.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square meters, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 500 square meters, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the thickness of the base course at intervals providing at least one measurement for each 500 square meters of base course or part thereof. Measure the thickness using test holes, at least 75 mm in diameter through the base course.

3.12.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and fully compacted course(s).

3.13 TRAFFIC

Do not allow traffic on the completed base course for airfield pavements. For roads, do not allow heavy equipment on the completed base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed base course, protect the area against marring or damage to the completed work.

3.14 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Immediately repair any defects and repeat repairs as often as necessary to keep the area intact. Retest any base course that was not paved over prior to the onset of winter to verify that it still complies with the requirements of this specification. Rework or replace any area of base course that is damaged as necessary to comply with this specification.

3.15 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that have been removed as directed. No additional payments will be made for materials that have to be replaced.

-- End of Section --
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DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 12 13

BITUMINOUS TACK AND PRIME COATS

05/17

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SECTION 32 12 13
BITUMINOUS TACK AND PRIME COATS
05/17

PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS K 2208 (2009) Asphalt Emulsion

1.2 SUBMITTALS

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SD-06 Test Reports
Sampling and Testing; G

1.3 QUALITY ASSURANCE

Certificates of compliance for asphalt materials delivered will be obtained and checked to ensure that specification requirements are met. Tack coat materials will not be diluted. Prime coat materials when emulsions are used can be diluted on site with potable water up to 1 part emulsion to 1 part water.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

1.5 EQUIPMENT, TOOLS AND MACHINES

1.5.1 General Requirements

Equipment, tools and machines used in the work are subject to approval. Maintain in a satisfactory working condition at all times. Calibrate equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment within 12 months of their use. If the
calibration expires during project, recalibrate the equipment before work can continue.

1.5.2 Bituminous Distributor

Provide a self propelled distributor with pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the surface being sprayed. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled total liquid rates from 0.14 to 4.5 L/square meter, with a pressure range of 172.4 to 517.1 kPa and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor will be capable of circulating and agitating the bituminous material during the heating process.

1.5.3 Heating Equipment for Storage Tanks

Use steam, electric, or hot oil heaters for heating the bituminous material. Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot come in contact with the bituminous material. Fix an armored thermometer to the tank with a temperature range from 4.4 to 204.4 degrees C so that the temperature of the bituminous material may be determined at all times.

1.5.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.6 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. A limited amount of moisture (approximately 0.14 liter/square meter) can be sprayed on the surface of unbound material when prime coat is used to improve coverage and penetration of asphalt material. Apply bituminous coat only when the atmospheric temperature in the shade is 10 degrees C or above and when the temperature has not been below 2 degrees C for the 12 hours prior to application, unless otherwise directed.

PART 2 PRODUCTS

2.1 PRIME COAT

2.1.1 Emulsified Asphalt

Provide emulsified asphalt conforming to JIS K 2208, Type PK-3. Asphalt emulsion can be diluted up to 1 part water to 1 part emulsion for prime coat use. Do not dilute asphalt emulsion for tack coat use.
2.2 TACK COAT

2.2.1 Emulsified Asphalt

Provide emulsified asphalt conforming to JIS K 2208, Type PK-4. For prime coats the emulsified asphalt can be diluted with up to 1 part emulsion to 1 part water. No dilution is allowed for tack coat applications.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. Apply treatment only when the surface is dry and clean.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.30 L nor more than 0.60 L/square meter of residual asphalt onto the pavement surface as approved by the Contracting Officer. Do not dilute asphalt emulsion when used as a tack coat.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 1.0 L nor more than 2.0 L/square meter of residual asphalt for asphalt emulsion up to a 1 to 1 dilution rate or for residual asphalt for cutback asphalt.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Apply asphalt at a temperature that will provide a viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec, kinematic. Furnish the temperature viscosity relation to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

<table>
<thead>
<tr>
<th>Asphalt Emulsion</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All Grades</td>
<td>20-70 degrees C</td>
</tr>
</tbody>
</table>
3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the bituminous distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots, not capable of being sprayed with the distributor, with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 8 meters of heating, distributing, and transferring operations of cutback materials. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat requirements are described herein.

3.4.2 Prime Coat

The prime coat is required if it will be at least 7 days before the asphalt mixture is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. Protect the underlying layer from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Repair (recompact or replace) damage to the underlying material caused by lack of, or inadequate, protection by approved methods at no additional cost to the Government. If the Contractor opts to use the prime coat, apply as soon as possible after consolidation of the underlying material. Apply the bituminous material uniformly over the surface to be treated at a pressure range of 172.4 to 517.1 kPa; the rate will be as specified above in paragraph APPLICATION RATE. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application remove and destroy the building paper.

3.4.3 Tack Coat

A tack coat should be applied to every bound surface (asphalt or concrete pavement) that is being overlaid with asphalt mixture and at transverse and longitudinal joints. Apply the tack coat when the surface to be treated is clean and dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate as specified above in paragraph APPLICATION RATE. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor by spraying with a hand wand or using other approved method. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that...
day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of asphalt mixture allow the bituminous coat to cure and water or volatiles to evaporate prior to overlaying. Maintain the tacked surface in good condition until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread enough sand to effectively blot up excess bituminous material.

3.6 FIELD QUALITY CONTROL

Obtain certificates of compliance for all asphalt material delivered to the project. Obtain samples of the bituminous material under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Furnish certified copies of the manufacturer's test reports indicating temperature viscosity relationship for cutback asphalt or asphalt cement, compliance with applicable specified requirements, not less than 5 days before the material is required in the work.

3.7.1 Sampling

Unless otherwise specified, sample bituminous material in accordance with JIS K 2251.

3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibrate using the approved job material and prior to applying the bituminous coat material to the prepared surface.

3.7.3 Trial Applications

Before applying the spray application of tack or prime coat, apply three lengths of at least 30 meters for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.23 L/square meter. Make other trial applications using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.66 L/square meter. Make other trial applications using various amounts of material as may be deemed necessary.
3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

-- End of Section --
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HOT-MIX ASPHALT (HMA) FOR ROADS

08/09

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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1122 (2014) Method of Test for Soundness of Aggregate by Use of Sodium Sulfate
JIS A 1137 (2014) Method of Test for Clay Lumps Contained in Aggregates
JIS A 5001 (2008) Crushed Stone for Road Construction
JIS A 5008 (2008) Limestone Filler for Bituminous Paving Mixtures

JAPAN ROAD ASSOCIATION (JRA)


1.2 GENERAL REQUIREMENTS

All materials, equipment, and construction procedures of hot-mix asphalt pavement for this project shall be in accordance with the Japan Road Association standards per publication identified in this specification.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
1.4 ENVIRONMENTAL REQUIREMENTS

Do not place the hot-mix asphalt upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3. The temperature requirements may be waived by the Contracting Officer, if requested; however, meet all other requirements, including compaction.

Table 3. Surface Temperature Limitations of Underlying Course

<table>
<thead>
<tr>
<th>Mat Thickness, mm</th>
<th>Degrees C</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 or greater</td>
<td>4</td>
</tr>
<tr>
<td>Less than 75</td>
<td>7</td>
</tr>
</tbody>
</table>

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections indicated. Construct each course to the depth, section, or elevation required by the drawings and roll, finish, and approve it before the placement of the next course.

2.2 AGGREGATES

Provide aggregates consisting of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the 5 mm sieve is coarse aggregate. The portion of material passing the 5 mm sieve and retained on the 0.074 mm sieve is fine aggregate. The portion passing the 0.074 mm sieve is defined as mineral filler. Submit all aggregate test results and samples to the Contracting Officer at least 14 days prior to start of construction.

2.2.1 Coarse Aggregate

Provide coarse aggregate consisting of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances and conforming to JIS A 5001. All individual coarse aggregate sources shall meet the following requirements:
### Percent Passing (by Weight)

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>S-20 (20-13 mm)</th>
<th>S-13 (13-5 mm)</th>
<th>S-5 (5-2.5 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>85 - 100</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>0 - 15</td>
<td>85 - 100</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>0 - 15</td>
<td>85 - 100</td>
</tr>
<tr>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>0 - 25</td>
</tr>
</tbody>
</table>

a. At least 75 percent by weight of the aggregate shall have two or more fractured faces in accordance with JRA HAP.

b. It shall be of uniform quality, clean, hard and durable, and shall not contain deleterious substances over the maximum percent by weight, such as clay or loam (0.25% maximum), soft stone pieces (5.0% maximum), and flat or elongated stone pieces (10.0% maximum) in accordance with JRA HAP.

c. Specific gravity shall be 2.45 or more when tested with JIS A 1110, water absorption shall be 3.0 percent or less when tested with JIS A 1110, and wear shall be not more than 30 percent when tested with JIS A 1121.

d. Soundness of aggregate shall be not more than 12 percent when tested with JIS A 1122.

#### 2.2.2 Fine Aggregate

Fine aggregate shall consist of natural or manufactured sand, and screenings conforming to JIS A 5001, except as modified herein. Fine aggregate shall meet requirements for wear and soundness specified for coarse aggregate. Since screenings may contain deleterious substances, such as silt and clay, it is necessary to perform sufficient examination before use. Clay lumps content shall be less than 0.25% when tested with JIS A 1137. Gradation of fine aggregate shall be as follows:

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>2.5</td>
<td>85 - 100</td>
</tr>
<tr>
<td>0.6</td>
<td>25 - 55</td>
</tr>
<tr>
<td>0.3</td>
<td>15 - 40</td>
</tr>
<tr>
<td>0.15</td>
<td>7 - 28</td>
</tr>
</tbody>
</table>
2.2.3 Mineral Filler

Mineral filler shall be pulverized limestone or igneous rock that is sufficiently dry and free of lumps and meeting the requirements of JIS A 5008. Moisture content shall be less than 1.0 percent, and specific gravity shall be more than 2.60 percent. Gradation of mineral filler shall be as follows:

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Percent Passing (by Weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6</td>
<td>100</td>
</tr>
<tr>
<td>0.15</td>
<td>Over 90</td>
</tr>
<tr>
<td>0.074</td>
<td>Over 70</td>
</tr>
</tbody>
</table>

2.2.4 Composition of Hot-Mix Asphalt Mixture

2.2.4.1 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 1 and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Binder Course (Max. 20 mm)</th>
<th>Wearing Course (Max. 20 mm)</th>
<th>Wearing Course (Max. 13 mm)</th>
</tr>
</thead>
</table>
2.2.4.2 Quantity of Asphalt Cement

Mix asphalt cement with aggregates of corresponding mixes in the following proportions:

<table>
<thead>
<tr>
<th>Sieve Size (mm)</th>
<th>Binder Course (Max. 20 mm)</th>
<th>Wearing Course (Max. 20 mm)</th>
<th>Wearing Course (Max. 13 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>5 - 16</td>
<td>10 - 21</td>
<td>10 - 21</td>
</tr>
<tr>
<td>0.15</td>
<td>4 - 12</td>
<td>6 - 16</td>
<td>6 - 16</td>
</tr>
<tr>
<td>0.074</td>
<td>2 - 7</td>
<td>4 - 8</td>
<td>4 - 8</td>
</tr>
</tbody>
</table>

2.3 ASPHALT CEMENT

Asphalt cement shall conform to JIS K 2207, penetration grade 40-60 (high traffic areas), 60-80 (general traffic conditions), 80-100 (snowy regions), and 100-120 (extremely cold places).

2.4 MIX DESIGN

a. Develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). Submit proposed JMF; do not produce hot-mix asphalt for payment until a JMF has been approved. The hot-mix asphalt shall be designed in accordance with Chapter 5 of the JRA HAP - Handbook for Asphalt Pavement and the criteria shown in Table 2.

2.4.1 JMF Requirements

- Source and proportions, percent by weight, of each ingredient of the mixture.
- Correct gradation, the percentages passing each size sieve listed in the specification for the mixture to be used, for the aggregate and mineral filler from each separate source and from each different size to be used in the mixture and for the composite mixture.
- Amount of material passing the JIS 0.074 mm sieve as determined by dry sieving.
- Number of blows of hammer compaction per side of molded specimen.
e. Temperature viscosity relationship of the asphalt pavement.

f. Stability, flow, percent voids in mineral aggregate, percent air voids, and unit weight.

g. Asphalt absorption by the aggregate.

h. Effective asphalt content as percent by weight of total mix.

i. Temperature of the mixture immediately upon completion of mixing.

j. Asphalt viscosity grade and/or penetration range.

k. Curves for the binder and wearing courses.

2.4.1.1 Marshall Test

Marshall test specimen of hot-mix asphalt mixture shall be prepared in a laboratory to determine the optimum composition of aggregates and the optimum quantity of asphalt cement. Aggregate gradation and asphalt cement content used in the mixtures shall be within the limits specified. Standard value for Marshall test shall be as follows:

<table>
<thead>
<tr>
<th>Type of Mixture</th>
<th>Binder Course</th>
<th>Wearing Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Blows (Traffic Classification C or heavier)</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Number of Blows (Traffic Classification B or lighter)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Percentage of Air Voids (%)</td>
<td>3-7</td>
<td>3-6</td>
</tr>
<tr>
<td>Voids Filled with Asphalt (%)</td>
<td>65-85</td>
<td>70-85</td>
</tr>
<tr>
<td>Marshall Stability (kgf)</td>
<td>500 or more</td>
<td>750 or more</td>
</tr>
<tr>
<td>Flow Value (1/100cm)</td>
<td>20-40</td>
<td>20-40</td>
</tr>
</tbody>
</table>

2.4.2 Adjustments to Field JMF

Keep the Laboratory JMF for each mixture in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, perform a new laboratory jmf design and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize
mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 3. Field (Plant) Established JMF Tolerances

<table>
<thead>
<tr>
<th>Sieves, mm</th>
<th>Adjustments (plus or minus), percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>2.5</td>
<td>3</td>
</tr>
<tr>
<td>0.074</td>
<td>1</td>
</tr>
<tr>
<td>Binder Content</td>
<td>0.4</td>
</tr>
</tbody>
</table>

If adjustments are needed that exceed these limits, develop a new mix design. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 1; while not desirable, this is acceptable, except for the 0.074 mm sieve, which shall remain within the aggregate grading of Table 1.

2.5 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement to produce a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 50 mm. The amount of RAP shall not exceed 30 percent.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

Heat the asphalt cement material avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

Heat and dry the aggregate for the mixture prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 175 degrees C when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

Accurately weigh or gauge the aggregates and the dry mineral filler and convey into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. Introduce required amount of asphalt...
into the mixer at a temperature at which it can be applied uniformly to the aggregate but not to exceed 163 degrees C. In batch mixing, after the aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, add asphalt by spraying or other approved methods, and continue mixing for a period of not less than 20 seconds or as much longer as may be required to obtain a homogeneous mixture. The time required to add or spray the asphalt into the mixer will not be added to the total wet-mixing time provided this operation does not exceed 10 seconds and a homogeneous mixture is obtained. The additional mixing time, when required, will be as directed. The temperature of the mixture at the time of discharge shall not exceed 168 degrees C. The temperature of the aggregate and mineral filler in the mixer shall not exceed 177 degrees C when the asphalt is added. When the mixture is prepared in a twin-pugmill mixer, the volume of the aggregates, mineral filler, and asphalt shall not extend above the tips of the mixer blades when the blades are in a vertical position. Overheated and carbonized mixtures, or mixtures that foam or show indication of free moisture, will be rejected. When free moisture is detected in batch mix plant produced mixture, withdraw the aggregates in the hot bins immediately and return to the respective stockpiles.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, clean the underlying course of dust and debris. Apply a [prime coat] [and/or] [tack coat] in accordance with the contract specifications.

3.4.1 Raising of Existing Manhole, Handhole, Valve Box and Catch Basin

If there are existing manhole, handhole, valve box and catch basins in existing asphalt concrete pavement to be overlaid, those shall be raised up to flush with the finished surface of new hot-mix asphalt pavement before new asphalt concrete is placed. Existing mortar leveling course under the manhole, handhole and valve box shall be replaced with new up to new level to provide a flush setting.

3.5 TESTING LABORATORY

Submit laboratory certification issued by the local prefectural or central government (Japan Ministry of Land, Infrastructure, Transport and Tourism (MLIT)). Use a laboratory to develop the JMF. The Government will inspect the laboratory equipment and test procedures prior to the start of hot mix operations. The laboratory shall maintain a valid certification for the duration of the project. A statement signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The statement shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.
3.6 TRANSPORTING AND PLACING

3.6.1 Transporting

Transport the hot-mix asphalt from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 60 degrees C. To deliver mix to the paver, use a material transfer vehicle operated to produce continuous forward motion of the paver.

3.6.2 Placing

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 3 m. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 300 mm; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 3 m from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 3 m. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.7 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. Compact the surface as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.8 JOINTS

The formation of joints shall be performed ensuring a continuous bond
between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.8.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. Remove the cutback material from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.8.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 80 degrees C at the time of placing adjacent lanes), or otherwise defective, shall be cut back a maximum of 75 mm from the top of the course with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.9 Finishing at Edge and Limit of Paving

Overlay of new hot-mix asphalt mixture shall be finished evenly in the same thickness indicated. Overlay shall be finished in gentle slope so that the edge of new overlaying pavement shall meet the edge elevation of existing asphalt concrete pavement. And where the drawing indicates "Limit of Paving," overlay shall be finished to provide a smooth transition to existing concrete pavement.

3.10 Compacted Earth Shoulder

Place and compact earth at edges of course for at least 30 cm of the shoulder.

3.11 QUALITY CONTROL

3.11.1 General Quality Control Requirements

Develop and submit an approved Quality Control Plan. Submit aggregate and QC test results. Do not produce hot-mix asphalt for payment until the quality control plan has been approved addressing all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design
b. Aggregate Grading
c. Quality of Materials
d. Stockpile Management
e. Proportioning
f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l. Surface Smoothness

3.11.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site. Laboratory facilities shall be kept clean and all equipment maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.11.3 Quality Control Testing

Perform all quality control tests applicable to these specifications in accordance with the testing criteria and frequency requirements as set forth in Chapter 6 of the JRA HAP - Handbook for Asphalt Pavement. Develop a Quality Control Testing Plan as part of a Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness.

3.11.3.1 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.11.3.2 QC Monitoring

Submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.11.4 Sampling

When directed by the Contracting Officer, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.
3.12 MATERIAL ACCEPTANCE

3.12.1 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 15 mm from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 7.6 m, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, test the final wearing surface of the pavement for conformance with the specified plan grade. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.12.2 Surface Smoothness

Perform all testing in the presence of the Contracting Officer. Keep detailed notes of the results of the testing and furnish a copy to the Government immediately after each day's testing. Use the profilograph method for all longitudinal testing, except where the runs would be less than 60 m in length and the ends where the straightedge will be used.

3.12.2.1 Smoothness Requirements

3.12.2.1.1 Straightedge Testing

The finished surfaces of the pavements shall have no abrupt change of 6 mm or more, and all pavements shall be within the tolerances of 6 mm in both the longitudinal and transverse directions, when tested with an approved 3 m straightedge.

3.12.2.1.2 Profilograph Testing

The finished surfaces of the pavements shall have no abrupt change of 3 mm or more, and each 0.1 km segment of each pavement lot shall have a Profile Index not greater than 140 mm/km when tested with an approved Japanese construction practice using profilometer. If the extent of the pavement in either direction is less than 60 m, that direction shall be tested by the straightedge method and shall meet requirements specified above.

3.12.2.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. Test each lot of the pavement in both a longitudinal and a transverse direction on parallel lines. Set the transverse lines 4.5 m or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lanes less than 6.1 m wide and at the third points...
for lanes 6.1 m or wider. Also test other areas having obvious deviations. Longitudinal testing lines shall be continuous across all joints.

3.12.2.2.1 Straightedge Testing

Hold the straightedge in contact with the surface and move it ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

3.12.2.2 Profilograph Testing

Perform profilograph testing using approved equipment and procedures. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 km segment of each pavement lot. Grade breaks on parking lots shall be accommodated by breaking the profile segment into shorter sections and repositioning the blanking band on each segment. The "blanking band" shall be 5 mm wide and the "bump template" shall span 25 mm with an offset of 7.5 mm. Compute the Profile Index for each pass of the profilograph in each 0.1 km segment. The Profile Index for each segment shall be the average of the Profile Indices for each pass in each segment. Furnish a copy of the reduced tapes to the Government at the end of each day's testing.

-- End of Section --
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-- End of Section Table of Contents --
1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1102 (2014) Method of Test for Sieve Analysis of Aggregates
JIS A 1103 (2014) Method of Test for Amount of Material Passing Test Sieve 75 µm in Aggregates
JIS A 1210 (2009) Test Method for Soil Compaction Using a Rammer
JIS A 5001 (2008) Crushed Stone for Road Construction

1.2 DEGREE OF COMPACTION

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in JIS A 1210 abbreviated as a percent of laboratory maximum dry density.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S"
are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools;

SD-06 Test Reports

Initial Tests; G
In-Place Tests; G

1.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide adequate equipment having the capability of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved in accordance with Section 01 45 00.00 1001 45 00.00 2001 45 00.00 40 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with JIS A 1201. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Testing

1.5.2.1 Sieve Analysis

Perform sieve analysis in conformance with JIS A 1103 and JIS A 1102 using sieves conforming to JIS Z 8801.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with JIS A 1205.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with paragraph DEGREE OF COMPACTION.
1.5.2.4 Field Density Tests

Measure field density in accordance with JIS A 1214.

1.5.2.5 Wear Test

Perform wear tests on aggregate surface course material in conformance with JIS A 1121.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 2 degrees C. It is the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the Contracting Officer. Bring surfaces damaged by freeze, rainfall, or other weather conditions to a satisfactory condition.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, slag, soil, or other approved materials processed and blended or naturally combined. Provide aggregates free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign materials. The Contractor is responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction and proof rolling operations have been completed. Aggregates shall conform to JIS A 5001, M-30/RM-30.

2.1.1 Coarse Aggregates

The material retained on the 5 mm sieve is known as coarse aggregate. Use only coarse aggregates that are reasonably uniform in density and quality. Use only coarse aggregate having a percentage of wear not exceeding 50 percent after 500 revolutions as determined by JIS A 1121. The amount of flat and/or elongated particles must not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source must meet the requirements set forth herein.

2.1.2 Fine Aggregates

The material passing the 5 mm sieve is known as fine aggregate. Fine aggregate consists of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

Gradation requirements specified in TABLE I apply to the completed aggregate surface. It is the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations. TABLE I shows permissible gradings for granular material used in aggregate surface roads and airfields. Use sieves conforming to JIS Z 8801.
GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>M-30 / RM-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5</td>
<td>100</td>
</tr>
<tr>
<td>31.5</td>
<td>95-100</td>
</tr>
<tr>
<td>19.0</td>
<td>60-90</td>
</tr>
<tr>
<td>4.75</td>
<td>30-65</td>
</tr>
<tr>
<td>2.36</td>
<td>20-50</td>
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<tr>
<td>0.425</td>
<td>10-30</td>
</tr>
<tr>
<td>0.075</td>
<td>2-10</td>
</tr>
</tbody>
</table>

2.2 LIQUID LIMIT AND PLASTICITY INDEX

The portion of the completed aggregate surface course passing the 0.425 mm sieve must have a maximum liquid limit of 35 and a plasticity index of 4 to 9.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed.

a. Sieve Analysis.

b. Liquid limit and plasticity index.

c. Moisture-density relationship.

d. Wear.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

2.3.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 STOCKPILING MATERIAL

Prior to stockpiling the material, clear and level the storage sites. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated.
Stockpile aggregates and binders obtained from different sources separately.

3.2 PREPARATION OF UNDERLYING COURSE SUBGRADE

Clean the underlying course subgrade and shoulders of all foreign substances. Do not construct the surface course on underlying course subgrade that is frozen material. Correct ruts or soft yielding spots in the underlying course subgrade, areas having inadequate compaction and deviations of the surface from the requirements set forth herein by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade and recompressing to density requirements specified in Section 31 00 00 EARTHWORK Section 32 11 20 BASE COURSE FOR RIGID AND SUBBASES FOR FLEXIBLE PAVING. Do not allow traffic or other operations to disturb the completed underlying course subgrade and maintain in a satisfactory condition until the surface course is placed.

3.3 GRADE CONTROL

During construction, maintain the lines and grades including crown and cross slope indicated for the aggregate surface course by means of line and grade stakes placed by the Contractor in accordance with the SPECIAL CONTRACT REQUIREMENTS.

3.4 MIXING AND PLACING MATERIALS

Mix and place the materials to obtain uniformity of the material and a uniform optimum water content for compaction. Make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

3.5 LAYER THICKNESS

Place the aggregate material on the underlying course subgrade in layers of uniform thickness. Compact the completed aggregate surface course to the thickness indicated. No individual layer may be thicker than 150 mm nor be thinner than 75 mm in compacted thickness. Compact the aggregate surface course to a total thickness that is within 13 mm of the thickness indicated. Where the measured thickness is more than 13 mm deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompressing as directed. Where the measured thickness is more than 13 mm thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 6 mm of the thickness indicated. Measure the total thickness of the aggregate surface course at intervals of one measurement for each 500 square meters of surface course. Measure total thickness using 75 mm diameter test holes penetrating the aggregate surface course.

3.6 COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in JIS A 1210 abbreviated herein as percent laboratory maximum density. Compact each layer of the aggregate surface course with approved compaction equipment, as required in the following paragraphs. Maintain the water content during the compaction procedure at optimum or at the percentage specified by the Contracting Officer. Compact the mixture with mechanical tampers in locations not accessible to
rollers. Continue compaction until each layer through the full depth is compacted to at least 100 percent of laboratory maximum density. Remove any materials that are found to be unsatisfactory and replace them with satisfactory material or rework them to produce a satisfactory material.

3.7 EDGES OF AGGREGATE SURFACE COURSE

Place approved material along the edges of the aggregate surface course in such quantity as to compact to the thickness of the course being constructed. Simultaneously roll and compact at least 300 mm of shoulder width with the rolling and compacting of each layer of the surface course when the course is being constructed in two or more layers.

3.8 SMOOTHNESS TEST

Construct each layer so that the surface shows no deviations in excess of 10 mm when tested with a 3 m straightedge applied both parallel with and at right angles to the centerline of the area to be paved. Correct deviations exceeding this amount by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.9 FIELD QUALITY CONTROL

3.9.1 In-Place Tests

Perform each of the following tests on samples taken from the placed and compacted aggregate surface course. Take samples and test at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square meters, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 500 square meters, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the thickness of the aggregate surface course at intervals providing at least one measurement for each 500 square meters of base course or part thereof. Measure the thickness using test holes, at least 75 mm in diameter through the aggregate surface course.

3.9.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and full coompacted aggregate surface course.

3.10 MAINTENANCE

Maintain the aggregate surface course in a condition that will meet all specification requirements until accepted.

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CONCRETE CURBS, GUTTERS AND SIDEWALKS

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CONCRETE CURBS, GUTTERS AND SIDEWALKS

05/18

PART 1   GENERAL

1.1    REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)


JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1101 (2014) Method of Test for Slump of Concrete

JIS A 1115 (2014) Method of Sampling Fresh Concrete

JIS A 1118 (2017) Method of Test for Air Content of Fresh Concrete by Volumetric Method

JIS A 1128 (2014) Method of Test for Air Content of Fresh Concrete by Pressure Method

JIS A 1132 (2014) Method of Making and Curing Concrete Specimens

JIS A 5308 (2014) Ready-Mixed Concrete

JIS A 5371 (2010) Precast Unreinforced Concrete Product

JIS A 5758 (2016) Sealants for Sealing and Glazing in Buildings

JIS G 3112 (2010) Steel Bars for Concrete Reinforcement


JIS K 6781 (1994) Polyethylene Films for Agriculture
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data
   Concrete; G
SD-06 Test Reports
   Field Quality Control

1.3 EQUIPMENT, TOOLS, AND MACHINES

1.3.1 General Requirements

Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Contracting Officer access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.3.2 Slip Form Equipment

Slip form paver or curb forming machines, will be approved based on trial use on the job and must be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 5 degrees C and is falling, or is already below that point. Placement may begin when the air temperature reaches 2 degrees C and is rising, or is already above 5 degrees C. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 2 degrees C, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. Prepare and protect the underlying material so that it is entirely free of frost when the concrete is deposited. Heat mixing water and aggregates as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C. Methods and equipment for heating must be approved. Use only aggregates that are free of ice, snow, and frozen lumps before entering the mixer. Provide covering or other means as needed to maintain the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.
1.4.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 30 degrees C except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 35 degrees C at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE, JIS A 5308 except as otherwise specified. Concrete must have a minimum compressive strength of 24 MPa at 28 days. Size of aggregate must not exceed 37.5 mm. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Use concrete mixtures that have an air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

Use concrete with a slump of 75 mm plus or minus 25 mm for hand placed concrete or 25 mm plus or minus 10 mm for slipformed concrete as determined in accordance with JIS A 1101.

2.1.3 Reinforcement Steel

Use reinforcement bars conforming to JIS G 3112. Use wire mesh reinforcement conforming to JIS G 3551.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Use impervious sheet materials conforming to JIS K 6781, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 White Pigmented Membrane-Forming Curing Compound

Use Japanese manufactured white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.
2.4 JOINT FILLER STRIPS

2.4.1 Expansion Joint Filler, Premolded

Unless otherwise indicated, use 10 mm thick Japanese manufactured premolded expansion joint filler conforming to ASTM D1751.

2.5 JOINT SEALANTS

Use Japanese manufactured cold-applied joint sealant conforming to JIS A 5758.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

2.6.1 Wood Forms

Use forms that are surfaced plank, 50 mm nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 3 m. Radius bends may be formed with 19 mm boards, laminated to the required thickness.

2.6.2 Steel Forms

Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 3 m and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.3 Sidewalk Forms

Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

2.6.4 Curb and Gutter Forms

Use curb and gutter outside forms that have a height equal to the full depth of the curb or gutter. Use rigid forms for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m or more, wheregrade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

2.6.5 Precast Concrete Curb or Precast Concrete Curb and Gutter

Precast concrete curb or precast concrete curb and gutter, where indicated, shall conform to JIS A 5371.
PART 3   EXECUTION

3.1   SUBGRADE PREPARATION

Construct subgrade to the specified grade and cross section prior to concrete placement.

3.1.1   Sidewalk Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2   Curb and Gutter Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK Section 32 11 23 AGGREGATE BASE COURSES. Test the subgrade for grade and cross section by means of a template extending the full width of the curb and gutter. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3   Maintenance of Subgrade

Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.2   FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 1.2 m. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1   Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 3 mm in any 3 m long section. After forms are set, grade and alignment must be checked with a 3 m straightedge. Sidewalks must have a transverse slope of 20 mm per meter. Unless otherwise indicated, construct sidewalks that are located adjacent to curbs with the low side adjacent to the curb. Do not remove side forms less than 12 hours after finishing has been completed.

3.2.2   Curbs and Gutters

Remove forms used along the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Do not remove forms used along the back of curb until the face and top of the curb have been finished, as specified for concrete finishing. Do not remove gutter forms
while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

Finish all slab edges, including those at formed joints, with an edger having a radius of 3 mm. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 8 mm from the testing edge of a 3 m straightedge. Permissible deficiency in section thickness will be up to 6 mm.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 13 mm. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in
the same manner as the gutter and curb top. Finish the top surface of gutter and entrance to grade with a wood float.

3.4.4 Joint Finishing

Finish curb edges at formed joints as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 6 mm from the testing edge of a 3 m straightedge. Permissible deficiency in section thickness will be up to 6 mm.

3.4.6 Precast Concrete Curbs or Precast Concrete Curb and Gutter

Precast concrete curbs or precast concrete curbs and gutters where used shall be installed to line and grade as indicated. Joint width shall be 10 mm. Cement mortar shall be provided to set the curbs and fill the joints. Where only precast concrete curb is used, gutter shall be constructed with cast-in-place concrete. Curbs and gutter shall be accomplished to match existing grade at transition point to existing curbs and gutters.

3.5 SIDEWALK JOINTS

Construct sidewalk joints to divide the surface into rectangular areas. Space transverse contraction joints at a distance equal to the sidewalk width or not to exceed 1.25 times the width, whichever is less, and continuous across the slab. Construct longitudinal contraction joints along the centerline of all sidewalks 3 m or more in width. Construct transverse expansion joints at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, install transverse expansion joints as indicated. Form expansion joints around structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 3 mm blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Form expansion joints using 10 mm joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1751. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 3 mm. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with
cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 10 degrees C. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces.

3.5.3 Reinforcement Steel Placement

Accurately and securely fasten reinforcement steel in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Construct curb and gutter joints at right angles to the line of curb and gutter.

3.6.1 Expansion Joints

Form expansion joints by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Construct expansion joints in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement using the same type and thickness of joints as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, provide expansion joints at least 10 mm in width at intervals not less than 10 meters nor greater than 36 meters. Seal expansion joints immediately following curing of the concrete or as soon thereafter as weather conditions permit. Seal expansion joints and the top 25 mm depth of curb and gutter contraction-joints with joint sealant. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 10 degrees C at the time of application of joint sealing material. Immediately remove excess material on exposed surfaces of the concrete and clean concrete surfaces. Precast concrete curbs will not require expansion joints.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 150 mm. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.
3.7.1.2 Impervious Sheeting Method

Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 300 mm when a continuous sheet is not used. Use sheeting that is not less than 450 mm wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

Apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Do not allow concrete surface to dry before application of the membrane. If drying has occurred, moisten the surface of the concrete with a fine spray of water and apply the curing compound as soon as the free water disappears. Apply curing compound in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters/L for the total of both coats. Apply the second coat in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied by the method and at the coverage specified above. Respray areas where the curing compound is damaged by subsequent construction operations within the curing period. Take precautions necessary to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. Tightly seal the top of the joint opening and the joint groove at exposed edges before the concrete in the region of the joint is resprayed with curing compound. Use a method used for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Adequately protect concrete surfaces to which membrane-curing compounds have been applied during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between
regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

3.7.4 Protective Coating

Apply a protective coating of linseed oil mixture to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Moist cure concrete to receive a protective coating.

3.7.4.1 Application

Complete curing and backfilling operation prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Spray apply at a rate of not more than 11 square meters/L for first application and not more than 15.5 square meters/L for second application, except that the number of applications and coverage for each application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Do not heat protective coating by direct application of flame or electrical heaters and protect the coating from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Do not apply material at ambient or material temperatures lower than 10 degrees C.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Take concrete samples in accordance with JIS A 1115 not less than once a day nor less than once for every 190 cubic meters of concrete placed. Mold cylinders in accordance with JIS A 1132 for strength testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa.

3.8.2.2 Air Content

Determine air content in accordance with JIS A 1118, or JIS A 1128. Use JIS A 1128 with concretes and mortars made with relatively dense natural
aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing foreman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Perform two slump tests on randomly selected batches of each class of concrete for every 190 cubic meters, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, reduce high areas either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed 6 mm. Remove and replace pavement areas requiring grade or surface smoothness corrections in excess of the limits specified.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Contracting Officer and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.
### PART 1 GENERAL

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  3.4.2 Turf Restoration

-- End of Section Table of Contents --
1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**JAPANESE INDUSTRIAL STANDARDS (JIS)**

- **JIS A 5308** (2014) Ready-Mixed Concrete
- **JIS A 5540** (2008) Turnbuckle for Building
- **JIS B 1180** (2014) Hexagon Head Bolts and Hexagon Head Screws
- **JIS B 1181** (2014) Hexagon Nuts and Hexagon Thin Nuts
- **JIS B 1256** (2008) Plain Washers
- **JIS G 3101** (2017) Rolled Steels for General Structure (Amendment 1)
- **JIS G 3444** (2016) Carbon Steel Tubes for General Structure
- **JIS G 3532** (2011) Low Carbon Steel Wires
- **JIS G 3533** (2008) Barbed Wires
- **JIS G 3552** (2011) Chain Link Wire Netting
- **JIS H 8641** (2007) Hot Dip Galvanized Coatings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

- **SD-02 Shop Drawings**
  - Fence Assembly; G
  - Location of Gate, Corner, End, and Pull Posts; G
  - Gate Assembly; G
Gate Hardware and Accessories; G
Erection/Installation Drawings; G

SD-03 Product Data
Fence Assembly; G
Gate Assembly; G
Gate Hardware and Accessories; G
Zinc Coating; G
PVC Coating; G
Fabric; G
Stretcher Bars; G
Barbed Wire; G
Precast Concrete Posts; G
Padlocks; G
Turnbuckles; G
Truss Rod; G
Tension Wires; G
Wire Ties; G
Concrete; G

SD-07 Certificates
Certificates of Compliance

SD-08 Manufacturer's Instructions
Fence Assembly
Gate Assembly
Hardware Assembly
Accessories

SD-11 Closeout Submittals
Recycled Material Content
1.3 QUALITY CONTROL

1.3.1 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

a. Zinc coating
b. PVC coating
c. Fabric
d. Stretcher bars
e. Gate hardware and accessories
f. Concrete

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide fencing and gate materials, as specified. Submit reports of listing chain-link fencing and accessories regarding weight in grams for zinc coating, thickness of PVC coating.

Submit manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories. Provide chain link fence on concrete posts for Okinawa Area and chain link fence on pipe posts for all other regions in Japan.

2.2 COMPONENTS FOR CHAIN LINK FENCE AND GATE

2.2.1 Fabric

Fabric for fence and gates shall be galvanized steel chain link wire netting conforming to JIS G 3552 No. 8, 50 mm standard wire mesh.

2.2.2 Posts, Rails and Braces

2.2.2.1 Fence Posts for Okinawa Area

Shall be the commercial precast concrete posts of the type and size as indicated.

2.2.2.2 Fence Posts for Other Regions in Japan

Shall be carbon steel pipe conforming to JIS G 3444, size and thickness as indicated, and galvanized.

2.2.2.3 Fence Rails and Braces, and Pipe Connectors

Shall be carbon steel pipe conforming to JIS G 3444, size and thickness as
indicated, and galvanized.

2.2.3 Structural Steel Bars, Plates and Shapes

Shall be JIS G 3101, SS 400, galvanized.

2.2.4 Barbed Wire

Shall be JIS G 3533, #12-gage, two-wire strand, a pitch of 102 mm, 4-pointed barbs and 2 to 7 twists.

2.2.5 Fastening Accessories

Shall be galvanized steel and shall be manufacturer's standard product.

2.2.6 Stretcher Bars

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 5 by 20 millimeter or of size as recommended by the fence manufacturer and conforming to JIS G 3101.

2.2.7 Stretcher Bar Bands

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 381 millimeter on center or of size as recommended by the fence manufacturer. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.2.8 Post Tops

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.2.9 Gate Posts

Shall be carbon steel pipe conforming to JIS G 3444, size and thickness as indicated, and galvanized.

2.2.10 Gates

2.2.10.1 Gate Assembly

Shape and size of the gate frame shall be as indicated. Framing and bracing members shall be of steel pipe specified herein.

2.2.10.2 Gate Leaves

For gate leaves, more than 2.44 m wide, provide intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Provide intermediate braces on all gate frames with an electro-mechanical lock. Attach fabric to the gate frame by method standard with the manufacturer except that welding will not be permitted.
2.2.10.3 Gate Hardware And Accessories

Submit manufacturer's catalog data. Furnish and install latches, hinges, stops, keepers, rollers, and other hardware items as required for the operation of the gate and shall be zinc-coated steel having weight of zinc-coating not less than HDZ 40B, JIS H 8641. Gate latches shall be fork or plunger bar type. Arrange latches for padlocking so that the padlock will be accessible from both sides of the gate. Provide stops for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.2.10.4 Turnbuckles for Gates

JIS A 5540, galvanized, size as indicated.

2.2.10.5 Truss Rod

Shall be JIS G 3101, 10 mm diameter, welded to fence post where indicated.

2.2.10.6 Tension Wires

Provide galvanized, coiled spring wire conforming to JIS G 3532 SWM-G3. Provide Zinc coating that weighs not less than 370 gram per square meter.

2.2.11 Wire Ties

Provide 2.3 millimeter galvanized steel wire conforming to JIS G 3532 for tying fabric to line posts, spaced 300 millimeter on center. For tying fabric to rails and braces, space wire ties 600 millimeter on center. For tying fabric to tension wire, space 2.7 millimeter hog rings 600 millimeter on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

Provide wire ties constructed of the same material as the fencing fabric. Provide accessories with polyvinyl (PVC) coatings when PVC-coated fence fabric is required.

2.2.12 Bolts, Nuts and Washers

Steel conforming to JIS B 1180, JIS B 1181, JIS B 1256 respectively.

2.2.13 Padlocks

Provide Japanese manufactured padlocks with keys and chain in conformance with the appropriate specification of the installation agency having jurisdiction.

2.3 OTHER MATERIALS

2.3.1 Zinc Coating

Hot dip galvanization shall be in conformance with JIS H 8641.
2.3.2 Cast-in-Place Concrete for Fence and Gate Posts

Shall be of size as indicated. Concrete in conformance with JIS A 5308 and shall be a minimum compressive strength of 18 MPa at 28 days.

2.3.3 Grout

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.4 GROUNDING

Ground the chain link fence and gates as indicated on drawings.

PART 3 EXECUTION

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

3.1 PREPARATION

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.1.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.2 INSTALLATION

3.2.1 Security

Install new chain link fencing, remove existing fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with Contracting Officer and cognizant Security Officer.

3.2.2 Fence Installation

Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.2.2.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 3.048 m on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 152.4 m on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 0.26 rad or more, or for abrupt changes in grade. Submit drawings showing location of gate, corner, end, and pull posts.

3.2.2.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 203 mm of
respective fabric line.

3.2.3 Excavation

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 3048 millimeter on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 75 millimeter below the bottoms of the posts. Set bottom of each post not less than 915 millimeter below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Remove excavated soil from Government property.

When solid rock is encountered near the surface, drill into the rock at least 305 millimeter for line posts and at least 457 millimeter for end, pull, corner, and gate posts. Drill holes at least 25.4 millimeter greater in diameter than the largest dimension of the placed post.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.2.4 Setting Posts

Remove loose and foreign materials from holes and moisten the soil prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 7 calendar days after placement or cured with a membrane curing material, as approved.

Grout all posts set into sleeved holes in concrete with an approved grouting material.

Maintain vertical alignment of posts in concrete construction until concrete has set.

3.2.4.1 Earth and Bedrock

Provide concrete bases of dimensions indicated on the manufactures installation drawings, except in bedrock. Compact concrete to eliminate voids, and finish to a dome shape. In bedrock, set posts with a minimum of 25.4 mm of grout around each post. Work grout into hole to eliminate voids, and finish to a dome shape.

3.2.4.2 Concrete Slabs and Walls

Set posts into zinc-coated sleeves, set in concrete slab or wall, to a minimum depth of 305 mm. Fill sleeve joint with lead, nonshrink grout, or other approved material. Set posts for support of removable fence sections into sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.
3.2.4.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 305 mm below top of fence, and two diagonal tension rods.

a. Tolerances

Provide posts that are straight and plumb within a vertical tolerance of 6.35 millimeter after the fabric has been stretched. Provide fencing and gates that are true to line with no more than 12.7 millimeter deviation from the established centerline between line posts. Repair defects as directed.

3.2.5 Concrete Strength

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 calendar days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified.

3.2.6 Supporting Arms (only for Security Chain Link Fence and Gates)

It is the Contractor's option to choose the following type of supporting arms; type (1) or type (2). Type (1): Supporting arm shall be top part of fence and gate post, which shall be one length, seamless pipe through post to arm. Type (2): If the selected manufacturer's standard product uses the sectional type supporting arms, that shall be designed to accommodate the top rail. Install supporting arms as recommended by the manufacturer. In addition to manufacturer's standard connections, securely anchor supporting arms to posts to prevent easy removal with hand tools.

3.2.7 Top Rails

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.2.8 Brace Assembly

Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.2.9 Tension Wire Installation

Install tension wire by weaving them through the fabric and tying them to each post with not less than 3.9 millimeter galvanized wire or by securing the wire to the fabric with 3.5 millimeter ties or clips spaced 610 millimeter on center.
3.2.10 Fabric Installation

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 38 millimeter above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.2.11 Stretcher Bar Installation

Thread stretcher bars through or clamped to fabric 102 millimeter on center and secured to posts with metal bands spaced 381 millimeter on center.

3.2.12 Barbed Wire (only for Security Chain Link Fence and Gate)

Install barbed wire on supporting arms above fence posts. Extend each end member of gate frames sufficiently above top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence. Pull each strand taut and securely fasten each strand to each supporting arm and extend member. The method of securing wires shall be as follows: twist tie barbed wire to arm using wire which has been looped through a hole in the supporting arm. Other methods of securing barbed wire are acceptable provided they are equally secure, and are approved in advance by the Contracting Officer.

3.2.13 Gate Installation

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.2.14 Tie Wires

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.2.15 Fasteners

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.2.16 Zinc-Coating Repair

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.2.17 Accessories Installation

3.2.17.1 Post Caps

Install post caps as recommended by the manufacturer.
3.2.17.2 Padlocks

Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

3.2.18 Grounding

Ground all fences crossed by overhead power lines in excess of 600 volts, and all electrical equipment attached to the fence. Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 15 m of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations can not exceed 198 m. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by power lines of 600 volts or more at or near the point of crossing and at distances not exceeding 45 m on each side of crossing.

Provide ground conductor consisting of No. 6 AWG solid copper wire. Provide copper-clad steel rod grounding electrodes 19 mm by 3.05 m long. Drive electrodes into the earth so that the top of the electrode is at least 152 mm below the grade. Where driving is impracticable, bury electrodes a minimum of 305 mm deep and radially from the fence, with top of the electrode not less than 610 mm or more than 2.4 m from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms.

3.3 CLOSEOUT ACTIVITIES

Remove waste fencing materials and other debris from the work site.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

3.4 RESTORATION

The Contractor shall restore all damaged and disturbed areas caused by this project work to match existing condition as directed.

3.4.1 Surface Course Restoration

Concrete and/or asphalt concrete surface course which has been damaged and disturbed to accomplish this project shall be restored to match existing condition with new concrete and/or new asphalt concrete, including crushed stone base course.

3.4.2 Turf Restoration

Sodded area which has been damaged and disturbed to accomplish this project shall be restored to match existing condition by reusing existing sod or new sod. Water thoroughly immediately after replanting.

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SECTION 33 11 00

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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)


U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01  (2016; with Change 1) Fire Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

UL 246  (2011; Reprint Dec 2018) UL Standard for Safety Hydrants for Fire-Protection Service

UL 262  (2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service

UL 312  (2010; Reprint Mar 2018) UL Standard for Safety Check Valves for Fire-Protection Service

UL 789  (2004; Reprint May 2017) UL Standard for Safety Indicator Posts for Fire-Protection Service

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5308  (2014) Ready-Mixed Concrete

JIS A 5314  (2014) Mortar Lining for Ductile Iron Pipes

JIS B 1171  (2015) Cup Head Square Neck Bolts (Amendment 1)

JIS B 1180  (2014) Hexagon Head Bolts and Hexagon Head Screws

JIS B 1181  (2014) Hexagon Nuts and Hexagon Thin Nuts

JIS B 2011  (2013) Bronze, Gate, Globe, Angle, and Check Valves (Amendment 2)
JIS B 2031 (2015) Gray Cast Iron Valves (Amendment 1)
JIS G 5526 (2014) Ductile Iron Pipes
JIS G 5527 (2014) Ductile Iron Fittings
JIS K 6353 (2011) Rubber Goods for Water Works
JIS K 6742 (2016) Unplasticized poly (vinyl chloride) (PVC-U) pipes for water supply
JIS K 6762 (2012) Double Wall Polyethylene Pipes for Water Supply

JAPAN WATER WORKS ASSOCIATION (JWWA)

JWWA B 120 (2017) Soft Seal Gate Valve for Water Supply
JWWA B 122 (2013) Ductile Cast Iron Gate Valve for Water Supply
JWWA B 129 (2013) Backflow Prevention Valve for Water Supply
JWWA B 137 (2013) Water Supply Rapid Air Valve
JWWA K 129 (2019) Rubber Ring-Shaped Rigid Polyvinyl Chloride Pipe for Water Supply
JWWA K 130 (2019) Rubber Ring-Shaped Rigid Polyvinyl
DEFINITIONS

1.2.1 Water Transmission Mains

Water transmission mains include water piping having diameters greater than 350 mm, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.2 Water Mains

Water mains include water piping having diameters 100 through 350 mm, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.3 Water Service Lines

Water service lines include water piping from a water main to a building service at a point approximately 1.5 m from building or the point indicated on the drawings, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.4 Additional Definitions

For additional definitions refer to the definitions in the applicable referenced standard.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with...
Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

**SD-03 Product Data**
- Fire Hydrants;
- Meters;
- Backflow Preventer;
- Disinfection Procedures; G

**SD-06 Test Reports**
- Backflow Preventer Tests; G
- Bacteriological Samples; G
- Hydrostatic Sewer Test; G
- Leakage Test; G
- Hydrostatic Test; G

**SD-07 Certificates**
- Fire Hydrants
- Backflow Certificate

**SD-08 Manufacturer's Instructions**
- Ductile Iron Piping
- PVC Piping
- PVCO Piping
- Polyethylene (PE) Pipe
- PVC Piping For Service Lines

### 1.4 QUALITY CONTROL

#### 1.4.1 Regulatory Requirements

Comply with NFPA 24 for materials, installation, and testing of fire main piping and components.

### 1.5 DELIVERY, STORAGE, AND HANDLING

#### 1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store
plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, fire hydrants, and other accessories free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, fire hydrants, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place other material, hooks, or pipe inside a pipe or fitting after the coating has been applied. Inspect the pipe for defects before installation. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging. Replace defective material without additional expense to the Government. Store rubber gaskets, not immediately installed, under cover or out of direct sunlight.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all materials in accordance with JIS, JWWA and other approved Japanese commercial products as indicated herein. Provide valves and fittings with pressure ratings equivalent to the pressure ratings of the pipe. Provide Japanese manufactured materials and components for fire protection service meeting the requirements of NFPA 24 and related UL standards.

2.1.1 Pipe, Fittings, Joints And Couplings

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on [and rubber-gasketed bell-and-spigot] joints. Include information concerning gaskets with submittal for joints and couplings.

2.1.1.1 Ductile-Iron Piping

2.1.1.1.1 Pipe and Fittings

Pipe, except flanged pipe, JIS G 5526 or JWWA G 113, Pressure Class [_____] Thickness Class [____]. Flanged pipe, JIS G 5527. Fittings, JIS G 5527 or JWWA G 113; fittings with push-on joint ends are to meet the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design. Provide fittings with pressure ratings equivalent to that of the pipe. Provide compatible pipe ends and fittings for the specified joints. Provide cement-mortar lining, JIS A 5314, twice the standard thickness on pipe and fittings.

2.1.1.1.2 Joints and Jointing Material

Provide push-on joints or mechanical joints for pipe and fittings unless otherwise indicated. Provide mechanical joints where indicated. Provide flanged joints where indicated. Provide mechanically coupled type joints using a sleeve-type mechanical coupling where indicated. Provide
insulating joints where indicated. Sleeve-type mechanical couplings in lieu of push-on joints are acceptable, subject to the limitations specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.

a. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly as recommended in JWWA K 156.

b. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets as recommended in JWWA K 156.

c. Flanged Joints: Bolts, nuts, and gaskets for flanged connections compatible with JIS G 5527 or JWWA G 113 joints. Provide JIS G 5527 ductile iron flanges. Provide epoxy coated steel set screw flanges. Gasket and lubricants for set screw flanges, in accordance with mechanical-joint gaskets conforming to JWWA K 156 or JIS B 2404.

d. Insulating Joints: Designed to prevent metal-to-metal contact at the joint between adjacent sections of piping. Provide flanged type joint with insulating gasket, insulating bolt sleeves, and insulating washers. Provide full face dielectric type gaskets, for JIS G 5527 fittings. Bolts and nuts, for JIS G 5527 fittings.

e. Sleeve-Type Mechanical Coupled Joints: As specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS.

2.1.1.1.3 Pipe, Joint, Valve, and Fitting Coatings

Provide epoxy resin bonded coating meeting the requirements of JDPA Z 2010. Bonded coating shall have minimum thickness of 0.1 mm for pipe and 0.08 mm for bends.

2.1.1.2 Plastic Piping

2.1.1.2.1 PVC and PVCO Piping

2.1.1.2.1.1 PVC Piping

JWWA K 129 or JIS K 6742 plain end or gasket bell end pipe, with a minimum Pressure Class 150 (DR27.5) with ductile iron outside diameter.

2.1.1.2.1.2 PVCO Piping

JWWA K 129 plain end or gasket bell end pipe, Pressure Class 165 PVCO pressure pipe, with ductile iron outside diameter.

2.1.1.2.1.3 Fittings for PVC and PVCO Pipe

Fittings shall be the same material as the pipe with elastomeric gaskets, in conformance with JWWA K 130 or JIS K 6742.

2.1.1.2.1.4 Joints and Jointing Material for PVC and PVCO Piping

a. Push-on joints: Use jointing material as recommended by PVC and PVCO pipe manufacturers between pipes, pipes and metal fittings, valves, and other accessories or compression-type joints/mechanical joints. Provide each joint connection with an elastomeric gasket compatible for the bell or coupling used. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, JIS K 6353 for
push-on joints and mechanical joints.

b. Mechanical Joint: Use mechanically coupled joints having a sleeve-type mechanical coupling, as specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS, as an optional jointing method for plain-end PVC pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling as specified for compression-type joints. Provide jointing material in conformance with PVC and PVCO pipe manufacturer's recommendation between pipe and sleeve-type mechanical couplings.

2.1.1.2.2 PVC Piping for Service Lines

2.1.1.2.2.1 Pipe and Fittings

Provide JIS K 6742 pipes and JIS K 6743 fittings.

2.1.1.2.2.2 Joints and Connections

Fittings may be joined by the solvent-cement method or threading.

2.1.1.2.2.3 Solvent Joining

Provide solvent joints per pipe manufacturer's recommendation.

2.1.1.2.3 Polyethylene (PE) Pipe

JWWA K 144 or JIS K 6762 with a minimum Pressure Class 200 (DR11) with ductile iron outside diameter.

2.1.1.2.3.1 Fittings For PE Pipe

JWWA K 145 or JWWA B 116.

2.1.1.2.3.2 Joints and Jointing Materials

Mechanical Joint: JWWA K 156 Mechanical joint adapter and gaskets for mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories.

2.1.1.3 Piping Beneath Railroad Right-of-Way

Piping passing under the right-of-way of a commercial railroad is to conform to the specifications for pipelines conveying nonflammable substances. Provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron railroad crossing casing pipe is to conform to and have strength computed in accordance with JIS G 5526.

2.1.2 Valves

Provide a JWWA compliant protective interior coating for all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion for water having a pH range from 4 to 9.

2.1.2.1 Gate Valves 80 mm Size and Larger on Buried Piping

a. JWWA B 120 or JWWA B 122: nonrising stem type with double-disc gate and
mechanical-joint ends or push-on joint ends compatible for the adjoining pipe

b. JWWA B 120 or JWWA B 122: nonrising stem type with mechanical-joint ends or resilient-seated gate valves 80 to 300 mm in size

c. JWWA compliant locally manufactured gate valve meeting the requirements of UL 262 for pipe protection service: inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 1200 kPa, and have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined.

Match materials for gate valves meeting UL 262 to the reference standards specified in JWWA B 120 or JWWA B 122. Gate valves open by counterclockwise rotation of the valve stem. Stuffing boxes have O-ring stem seals, except for those valves for which gearing is specified, in which case use conventional packing in place of O-ring seal. Stuffing boxes are bolted and constructed so as to permit easy removal of parts for repair. Use gate valves with special ends for connection to sleeve-type mechanical coupling in lieu of mechanical-joint ends and push-on joint ends.

Provide valve ends and gaskets for connection to sleeve-type mechanical couplings that conform to the requirements specified respectively for the joint or coupling. Provide JWWA B 122 mm gate valves with gearing and indicator. Where an indicator post are shown, provide an indicator post flange for JWWA B 122 or locally manufactured gate valves conforming to the requirements of UL 262. Provide all valves from one manufacturer.

2.1.2.2 Gate Valves 75 mm Size and Larger in Valve Pit(s) and Aboveground Locations

a. JWWA B 120 or JWWA B 122 or JIS B 2031: nonrising stem type with double-disc gates and flanged ends

b. JWWA B 120 or JWWA B 122 or JIS B 2031: nonrising stem type with flanged ends

c. JWWA B 120 or JWWA B 122 or JIS B 2031 or JWWA compliant locally manufactured gate valve meeting the requirements of UL 262 for fire protection service: inside-screw type, with double-disc or split-wedge type gate and flanged ends, and designed for a hydraulic working pressure of 1200 kPa

Match materials for gate valves meeting UL 262 to the reference standards specified in JWWA B 120 or JWWA B 122 or JIS B 2031. Provide gate valves with handwheels that open by counterclockwise rotation of the valve stem. Bolt and construct stuffing boxes so as to permit easy removal of parts for repair. Provide all valves from one manufacturer.

2.1.2.3 Check Valves

Provide a JWWA compliant protective interior coating for all valves whose interiors are exposed to sea water or salt water, or where there is a serious corrosion problem other than galvanic corrosion for water having a pH range from 4 to 9.

a. JWWA B 129 or JIS B 2031: Iron or steel body and cover and flanged ends

b. JWWA compliant locally manufactured check valve meeting the
requirements of UL 312 for fire protection service: Cast iron or steel body and cover, flanged ends, and designed for a minimum working pressure of 1000 kPa.

Materials for check valves meeting UL 312 are to match the reference standards specified in JWWA B 129. Provide check valves with a clear port opening. Provide all check valves from one manufacturer.

2.1.2.4 Rubber-Seated Butterfly Valves

Provide rubber-seated butterfly valves and wafer type valves that match the performance requirements of JWWA B 138. Wafer type valves not meeting laying length requirements are acceptable if supplied and installed with a spacer, providing the specified laying length. Meet all tests required by JWWA B 138. Flanged-end valves are required in a pit. Provide a union or sleeve-type coupling in the pit to permit removal. Direct-bury mechanical-end valves 80 through 250 mm in diameter. Provide a valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Provide valve operators that restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.1.2.5 Pressure Reducing Valves

Maintain a constant downstream pressure regardless of fluctuations in demand. Using pressure reducing valves capable of providing 1720 kPa operating pressure on the inlet side, with outlet pressure set for 340 kPa. Provide hydraulically-operated, pilot controlled, globe or angle type valves that are capable of being actuated either by diaphragm or piston. Provide diaphragm-operated, adjustable, spring-loaded type pilot controls made of lead-free bronze with stainless steel working parts, designed to permit flow when controlling pressure exceeds the spring setting. Construct the bodies of bronze, cast iron or cast steel with lead-free bronze trim; the valve stem of stainless steel; the seat of lead-free bronze; and the valve discs and diaphragms of synthetic rubber. Provide flanged ends.

2.1.2.6 Air Release, Air/Vacuum, and Combination Air Valves

Provide JWWA B 137 air release, air vacuum and combination air valves that release air and prevent the formation of a vacuum. Provide valves with an iron body, lead-free bronze trim and stainless steel float that automatically releases air when the lines are being filled with water and admits air into the line when water is being withdrawn in excess of the inflow.

2.1.2.7 Water Service Valves

2.1.2.7.1 Gate Valves Smaller than 75 mm in Size on Buried Piping

Gate valves smaller than 75 mm size on Buried Piping JIS B 2011, Class 150, solid wedge, nonrising stem, with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.

2.1.2.7.2 Gate Valves Smaller Than 75 mm Size in Valve Pits

JIS B 2011, Class 150, solid wedge, inside screw, rising stem. Provide valves with flanged or threaded end connections, a union on one side of the valve, and a handwheel operator.
2.1.2.7.3 Check Valves Smaller than 50 mm in Size

Provide check valves with a minimum working pressure of 1000 kPa or as indicated with a clear waterway equal to the full nominal diameter of the valve. Valves open to permit flow when inlet pressure is greater than the discharge pressure, and close tightly to prevent return flow when discharge pressure exceeds inlet pressure. Cast the size of the valve, working pressure, manufacturer's name, initials, or trademark on the body of each valve.

Provide valves for screwed fittings, made of lead-free bronze and in conformance with JIS B 2011, Class 150, Types compatible for the application.

2.1.2.8 Indicator Post

Provide upright gate valve with indicator post conforming to JWWA compliant local commercial products meeting the requirements of UL 789 and NFPA 24. Construct indicator post body of cast iron, ductile iron or a combination of both, bronze operating nut, cast iron locking wrench with open and shut target window.

2.1.2.9 Valve Boxes

Provide a valve box for each gate valve on buried piping, except where indicator post is shown. Construct adjustable valve boxes manufactured from cast iron of a size compatible for the valve on which it is used. Provide cast iron valve boxes conforming to JCW-104. Coat the cast-iron box with a heavy coat of bituminous paint. Provide a round head. Cast the word "WATER" on the lid. The minimum diameter of the shaft of the box is 135 mm or as indicated.

2.1.2.10 Valve Pits

Construct the valve pits at locations indicated or as required above and in accordance with the details shown.

2.1.3 Blowoff Valve Assemblies

Provide blowoff valve assemblies complete with all pipe, fittings, valve, valve box, riser box and lid, riser extension, discharge fitting and other materials required to connect to the water main. Provide blow off valve assemblies 100 mm or larger conforming to JWWA compliant local commercial products.

2.1.4 Fire Hydrants

2.1.4.1 Fire Hydrants

Provide fire hydrants where indicated. Paint fire hydrants with at least one coat of primer and two coats of enamel paint. Paint barrel and bonnet colors in accordance with UFC 3-600-01. Stencil fire hydrant number and main size on the fire hydrant barrel using black stencil paint.

Provide a JWWA compliant protective epoxy interior coating on those portions of the fire hydrant continuously in contact with sea water or salt water.
2.1.4.1.1  Dry-Barrel Type and Wet-Barrel Type Fire Hydrants

Provide Dry-barrel type fire hydrants conforming to JWWA compliant local commercial product of aboveground fire hydrants and meeting the requirements of UL 246, "Base Valve" with 150 mm inlet, 135 mm valve opening, one 115 mm pumper connection, and two 65 mm hose connections. Provide Wet-barrel type fire hydrants conforming to JWWA compliant local commercial product of aboveground fire hydrants and meeting the requirements of UL 246, "Wet Barrel" with 150 mm inlet, one 115 mm pumper connection, and two 65 mm hose connections. Individually valve pumper connection and hose connections with independent nozzle gate valves. The locally manufactured and JWWA compliant commercial product of fire hydrants shall be compatible with the 115 mm pumper and two 65 mm hose connection and shall be of the type as applicable to U.S. military construction projects in Japan.

Provide mechanical-joint or push-on joint end inlet, except where flanged end is indicated. Provide fire hydrants with breakable features. Provide fire hydrant with special couplings joining upper and lower sections of fire hydrant barrel and upper and lower sections of fire hydrant stem that break from a force imposed by a moving vehicle.

2.1.5  Meters

Submit certificates certifying all required and recommended tests set forth in the referenced standard and JIS B 8570-1 have been performed and comply with all applicable requirements of the referenced standard and JIS B 8570-1 within the past three years. Include certification that each meter has been tested for accuracy of registration and that each meter complies with the accuracy and capacity requirements of the referenced standard when tested in accordance with JIS B 7552.

Include a register with all meters whether they are or are not connected to a remote reading system.

2.1.5.1  Propeller Type Meters

Provide Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible meter for waterworks of sizes 50mm to 1800mm, conforming to JWWA compliant local commercial products. Flow tubes or main cases constructed of cast iron or fabricated steel with JWWA compliant protective coating.

2.1.5.2  Displacement Type Meters

Provide Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible meter for waterworks of sizes 50 mm or smaller, conforming to JWWA compliant local commercial products. Pressure casings constructed of copper alloy containing not less than 75 percent copper. Provide registers with non-breakable covers and straight-reading registers. Provide non-breakable covers of copper alloy containing not less than 75 percent copper. For meter sizes 13mm through 25 mm provide frost-protection-type design.

2.1.5.3  Compound Type Meters

Provide Advanced Metering Infrastructure (AMI) and Direct Digital Communication (DDC) compatible meter with strainers for waterworks of sizes 50 mm through 200 mm, conforming to JWWA compliant local commercial
products. Main casing constructed of cast iron or fabricated steel with JWWA compliant protective coating. Equip with tapped bosses near the outlet for field testing purposes.

2.1.5.4 Register

Provide open straight-reading register supplied by the meter manufacturer. Equip register with cubic meters readings. Use encoder type remote register designed in accordance with JWWA compliant local commercial product of water meter.

2.1.5.5 Strainers

Provide strainer recommended and supplied by the local meter manufacturer. Provide strainer of the same material as the meter body (i.e., bronze, ductile, or stainless).

2.1.5.6 Meter Connections

Provide connections compatible with the type of pipe and conditions encountered.

2.1.5.7 Advanced Metering Infrastructure

The Government will supply an Advanced Metering Infrastructure (AMI) compatible water meter(s) for the Contractor to install and connect to the existing AMI Data Acquisition System (DAS). Use the existing Government laptop computers to configure the meter using existing software loaded on the computer. Modifications to existing software on the computer or the addition of software to the computer is not allowed. The Contractor must ensure that the meter(s) transmit the metered data to the DAS. The current meters being used by [_____] are: [______].

2.1.5.8 Direct Digital Control System Interface

Provide all meters with the capability of providing pulse output to the DDC system.

2.1.5.9 Meter Setter

For water meter 50 mm or greater, provide a by-pass assembly with the valve located outside the vault. Provide valve box for valve located outside of vault.

2.1.5.10 Meter Boxes Vaults

Provide meter boxes vaults of sufficient size to completely enclose the meter and shutoff valve or service stop and in accordance with the details shown on the drawings. Provide a meter boxes or vaults with a height equal to the distance from invert of the service line to finished grade at the meter location.

2.1.5.10.1 Cast Iron

Provide cast iron meter box and lid. Provide a round lid with precast holes for remote electronic meter reading modules having the word "WATER" cast on the top surface.
2.1.5.10.2 Meter Boxes Vaults

2.1.5.10.2.1 Vault Access Door

Provide a single-leaf or double-leaf cast-in aluminum or painted steel diamond-plate access door with the following dimensions:

- Width: [_____] mm
- Length: [_____] mm

Include stainless steel spring or pneumatic lift assist, type 316 stainless steel slam locking latch, automatic hold-open arm with a red release handle, and flush mounted retractable lifting handle. Door must have a minimum load rating 6,800 kg load.

2.1.5.10.2.2 Fittings

Provide flanged fittings for pipe 75 mm and larger.

2.1.5.10.2.3 Vault Valves

Provide ball or outside screw and yoke (OS&Y) or butterfly valves in meter vault.

2.1.6 Backflow Preventers

Provide a JWWA compliant local commercial product reduced pressure principle type backflow preventer meeting the following requirements:

- Size: [____]
- Maximum Rated Flow: [____]
- Allowable Pressure Loss: [____]
- Flanged cast iron, mounted gate valve
- Strainer of the same material as the backflow preventer

The particular make, model, and size of backflow preventers to be installed must be included in the latest edition of the List of Approved Backflow Prevention Assemblies and be accompanied by a backflow certificate. Select materials for piping, strainers, and valves used in assembly installation that are galvanically compatible. Materials joined, connected, or otherwise in contact are to have no greater than 0.25 V difference on the Anodic Index, unless separated by a dielectric type union or fitting.

2.1.6.1 Backflow Preventer Enclosure

Provide an insulated enclosure where freezing temperature are possible.

2.1.7 Disinfection

Chlorinating materials are to conform to: Chlorine, Liquid: JIS K 1102; Hypochlorite, Calcium and Sodium: Approved local commercial product.
2.2 ACCESSORIES

2.2.1 Pipe Restraint

2.2.1.1 Thrust Blocks

Use JIS A 5308 concrete having a minimum compressive strength of 18 MPa at 28 days.

2.2.1.2 Joint Restraint

Provide restrained joints in accordance with NFPA 24, Chapter 10 and in accordance with applicable JWWA standard test method for joint restrain. Provide mechanical joint restraint restraint devices with gripper wedges incorporated into a follower gland and specifically designed for the pipe material and meeting the requirements of JIS G 5527 or metal harness fabricated by the pipe manufacturer.

2.2.2 Protective Enclosures

Provide Freeze-Protection Enclosures that are insulated and designed to protect aboveground water piping, equipment, or specialties from freezing and damage.

2.2.3 Tapping Sleeves

Provide cast gray, ductile, malleable iron or stainless steel, split-sleeve type tapping sleeves of the sizes indicated for connection to existing main with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Utilize similar metals for bolts, nuts, and washers to minimize the possibility of galvanic corrosion. Provide dielectric gaskets where dissimilar metals adjoin. Provide a tapping sleeve assembly with a maximum working pressure of 1000 kPa. Provide bolts with square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, utilize an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pre-torqued to 67.8 Newton meters.

2.2.4 Sleeve-Type Mechanical Couplings

Use couplings to join plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling consists of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. Provide true circular middle ring and the follower rings sections free from irregularities, flat spots, and surface defects; provide for confinement and compression of the gaskets. For ductile iron and PVC pipe, the middle ring is cast-iron; and the follower rings are malleable or ductile iron. Use gaskets for resistance to set after installation and to meet the requirements specified for gaskets for mechanical joint in JIS B 2404. Provide track-head type bolts JIS B 1180, with nuts, JIS B 1181; or round-head square-neck type bolts, JIS B 1171 with hex nuts JIS B 1181. Provide 16 mm diameter bolts. Shape bolt holes in follower rings to hold...
fast to the necks of the bolts used. Do not use mechanically coupled joints using a sleeve-type mechanical coupling as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint. Provide a tight flexible joint with mechanical couplings under reasonable conditions, such as pipe movements caused by expansion, contraction, slight settling or shifting in the ground, minor variations in trench gradients, and traffic vibrations. Match coupling strength to that of the adjoining pipeline.

2.2.5 Insulating Joints

Provide a rubber-gasketed insulating joint or dielectric coupling between pipe of dissimilar metals which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.6 Bonded Joints

For all ferrous pipe, provide a metallic bond at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. Provide Size 1/0 copper conductor thermal weld type bond wire designed for direct burial and shaped to stand clear of the joint.

2.2.7 Dielectric Fittings

Install dielectric fittings between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains to prevent metal-to-metal contact of dissimilar metallic piping elements and compatible with the indicated working pressure.

2.2.8 Tracer Wire for Nonmetallic Piping

Provide a continuous bare copper or aluminum wire not less than 2.5 mm in diameter in sufficient length over each separate run of nonmetallic pipe.

2.2.9 Water Service Line Appurtenances

2.2.9.1 Corporation Stops

Ground key type; lead-free bronze, compatible with the working pressure of the system and solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, coupling nut for connection to flared copper tubing.

2.2.9.2 Curb or Service Stops

Ground key, round way, inverted key type; made of lead-free bronze, and compatible with the working pressure of the system. Provide compatible ends for connection to the service piping. Cast an arrow into body of the curb or service stop indicating direction of flow.

2.2.9.3 Service Clamps

Provide single or double flattened strap type service clamps used for repairing damaged cast-iron, steel or PVC pipe with a pressure rating not less than that of the pipe being repaired. Provide clamps with a galvanized malleable-iron body with cadmium plated straps and nuts and a rubber gasket cemented to the body.
2.2.9.4 Goosenecks

Manufacture goosenecks from Type K copper tubing; provide joint ends for goosenecks compatible with connecting to corporation stop and service line. Where multiple gooseneck connections are required for an individual service, connect goosenecks to the service line through a compatible lead-free brass or bronze branch connection; the total clear area of the branches to be at least equal to the clear area of the service line.

2.2.9.5 Curb Boxes

Provide a curb box for each curb or service stop manufactured from cast iron, size capable of containing the stop where it is used. Provide a round head. Cast the word "WATER" on the lid. Factory coat the box with a heavy coat of bituminous paint.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Connections to Existing System

Perform all connections to the existing water system in the presence of the Contracting Officer.

3.1.2 Operation of Existing Valves

Do not operate valves within or directly connected to the existing water system unless expressly directed to do so by the Contracting Officer.

3.1.3 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.2 INSTALLATION

Install all materials in accordance with the applicable reference standard, manufacturers instructions and as indicated herein.

3.2.1 Piping

3.2.1.1 General Requirements

Install pipe, fittings, joints and couplings in accordance with the applicable referenced standard, the manufacturer's instructions and as specified herein.

3.2.1.1.1 Termination of Water Lines

Terminate the work covered by this section at a point approximately 1.5 m from the building, unless otherwise indicated.

Do not lay water lines in the same trench with gas lines, fuel lines, electric wiring, or any other utility. Do not install copper tubing in the same trench with ferrous piping materials. Where nonferrous metallic pipe (i.e., copper tubing) crosses any ferrous piping, provide a minimum vertical separation of 300 mm between pipes.
3.2.1.1.2 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Under no circumstances is it permissible to drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe cleanly, squarely, and accurately to the length established at the site and work into place without springing or forcing. Replace a pipe or fitting that does not allow sufficient space for installation of jointing material. Blocking or wedging between bells and spigots is not permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at the design elevation and grade. Secure firm, uniform support. Wood support blocking is not permitted. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports for fastening work into place. Make provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been assembled. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. [Provide a minimum of 760 mm depth of cover over top of pipe under non-traffic areas and minimum of 900 mm under traffic areas.]

3.2.1.1.3 Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.2.1.1.4 Connections to Existing Water Lines

Make connections to existing water lines after coordination with the facility and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped and as indicated.

3.2.1.1.5 Sewer Manholes

No water piping is to pass through or come in contact with any part of a sewer manhole.

3.2.1.1.6 Water Piping Parallel With Sewer Piping

Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer than 3.0 m, horizontally, from any sewer line.

a. Normal Conditions: Lay water piping at least 3.0 m horizontally from sewer or sewer manhole whenever possible. Measure the distance from outside edge to outside edge of pipe or outside edge of manhole. When local conditions prevent horizontal separation install water piping in a separate trench with the bottom of the water piping at least 450 mm above the top of the sewer piping.

b. Unusual Conditions: When local conditions prevent vertical separation, construct sewer piping of JWWA compliant ductile iron water piping and...
perform hydrostatic sewer test, without leakage, prior to backfilling. When local conditions prevent vertical separation, test the sewer manhole in place to ensure watertight construction.

3.2.1.1.7 Water Piping Crossing Sewer Piping

Provide at least 450 mm above the top (crown) of the sewer piping and the bottom (invert) of the water piping whenever possible. Measure the distance edge-to-edge. Where water lines cross under gravity sewer lines, construct sewer line of JWWA compliant ductile iron water piping with rubber-gasketed joints and no joint located within 3 m horizontally, of the crossing. Lay water lines which cross sewer force mains and inverted siphons at least 600 mm above these sewer lines; when joints in the sewer line are closer than 900 mm horizontally from the water line relay the sewer line to ensure no joint closer than 900 mm.

a. Normal Conditions: Provide a separation of at least 450 mm between the bottom of the water piping and the top of the sewer piping in cases where water piping crosses above sewer piping.

b. Unusual Conditions: When local conditions prevent a vertical separation described above, construct sewer piping passing over or under water piping of JWWA compliant ductile iron water piping and perform hydrostatic sewer test, without leakage, prior to backfilling. Construct sewer crossing with a minimum 6.1 m length of the JWWA compliant ductile iron water piping, centered at the point of the crossing so that joints are equidistant and as far as possible from the water piping. Protect water piping passing under sewer piping by providing a vertical separation of at least 450 mm between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on or damage to the water piping.

3.2.1.1.8 Penetrations

Provide ductile-iron or Schedule 40 steel wall sleeves for pipe passing through walls of valve pits and structures. Fill annular space between walls and sleeves with rich cement mortar. Fill annular space between pipe and sleeves with mastic.

3.2.1.1.9 Flanged Pipe

Only install flanged pipe aboveground or with the flanges in valve pits.

3.2.1.2 Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the requirements of JDPA T 01 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of pipe manufacturer for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of pipe manufacturer for joint assembly. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and
other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a flanged joint as specified, replace it. Use set screw flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the set screw flange manufacturer. During installation of set screw gasket provide for confinement and compression of gasket when joint to adjoining flange is made. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer. Make insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints, except that bolts with insulating sleeves are to be full size for the bolt holes. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

b. Allowable Deflection: Follow ductile iron pipe manufacturer's recommendation for the maximum allowable deflection. If the alignment requires deflection in excess of the above limitations, provide special bends or a sufficient number of shorter lengths of pipe to achieve angular deflections within the limit set forth.

c. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene film, in conformance with JWWA K 158.

3.2.1.3 PVC and PVCO Water Main Pipe

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS for laying of pipe, joining PVC pipe to fittings and accessories, setting of fire hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance per pipe manufacturer's installation instructions.

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use a lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections; assemble push-on joints for connection to fittings, valves, and other accessories; make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel; assemble joints made with sleeve-type mechanical couplings, all in accordance with pipe manufacturer's installation instructions.

b. Joint Offset: Construct joint offset. Do not exceed the minimum longitudinal bending as recommended by pipe manufacturer.

c. Fittings: Install in accordance with PVC and PVCO pipe manufacturer's installation standards.
3.2.1.4 Polyethylene (PE) Piping

Install PE pipes in accordance with pipe manufacturer's installation instruction.

3.2.1.5 Plastic Service Piping

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements, pipe manufacturer's installation instructions, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with pipe manufacturer's installation instructions.

3.2.1.5.1 Jointing

Make solvent-cemented joints for PVC piping using the solvent cement previously specified for this material; assemble joints in accordance with pipe manufacturer's installation instructions. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.5.2 Plastic Pipe Connections to Appurtenances

Connect plastic service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.2.1.6 Fire Protection Service Lines for Sprinkler Supplies

Connect water service lines used to supply building sprinkler systems for fire protection to the water main in accordance with NFPA 24.

3.2.1.7 Water Service Piping

3.2.1.7.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 1.5 m from the building line at the points indicated; close such water service lines with plugs or caps.

3.2.1.7.2 Water Service Line Connections to Water Mains

Connect water service lines to the main by a corporation stop and gooseneck and install a service stop below the frostline. Connect water service lines to ductile-iron water mains in accordance with pipe manufacturer's installation instructions for service taps. Connect water service lines to PVC water mains in accordance with pipe manufacturer's installation instructions.

3.2.2 Railroad Right-of-Way

Install piping passing under the right-of-way of a commercial railroad in accordance with the specifications for pipelines conveying nonflammable substances. For PVC water main pipe, also install in accordance with the recommendations of pipe manufacturer for installation of casings.
3.2.3 Meters

Install meters and meter boxes vaults at the locations shown on the drawings. Center meters in the boxes vaults to allow for reading and ease of removal or maintenance. Set top of box or vault at finished grade.

3.2.4 Backflow Preventers

Install backflow preventers of type, size, and capacity indicated a minimum of 300 mm and a maximum of 900 mm above concrete base. Include valves and test cocks. Install according to the manufacturers requirements and the requirements of plumbing and health department and authorities having jurisdiction. Support NPS 63 mm and larger backflow preventers, valves, and piping near floor with 300 mm minimum air gap, and on concrete piers or steel pipe supports. Do not install backflow preventers that have a relief drain in vault or in other spaces subject to flooding. Do not install by-pass piping around backflow preventers.

3.2.4.1 Backflow Preventer Enclosure

Install a level concrete base with top of concrete surface approximately 50 mm above grade. Install protective enclosure over valve and equipment. Anchor protective enclosure to concrete base.

3.2.5 Disinfection

Disinfection of systems supplying non-potable water is not required.

Prior to disinfection, provide disinfection procedures, proposed neutralization and disposal methods of waste water from disinfection as part of the disinfection submittal. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with the applicable JWWA standards. Ensure a free chlorine residual of not less than 10 mg/L after 24 hour holding period and prior to performing bacteriological tests.

3.2.6 Flushing

Perform bacteriological tests prior to flushing. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 mg/L, the residual chlorine content of the distribution system, or acceptable for domestic use. Use neutralizing chemicals as recommended by JWWA standards.

3.2.7 Pipe Restraint

3.2.7.1 Concrete Thrust Blocks

Install concrete thrust blocks where indicated.

3.2.7.2 Restrained Joints

Install restrained joints in accordance with the manufacturer's instructions or NFPA 24 where indicated. For metal harness use tie rods and clamps as shown in NFPA 24. Provide metal harness fabricated by the pipe manufacturer and furnished with the pipe.
3.2.8 Valves

3.2.8.1 Gate Valves

Install gate valves in accordance with the requirements for valve-and-fitting installation and with the recommendations of the gate valve manufacturer. Install gate valves on PVC and PVCO water mains in accordance with the recommendations of the gate valve manufacturer. Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.8.2 Check Valves

Install check valves in accordance with the applicable requirements for valve-and-fitting installation, except as otherwise indicated. Make and assemble joints to check valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.8.3 Air Release, Air/Vacuum, and Combination Air Valves

Install pressure vacuum assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to the requirements of plumbing and health department and authorities having jurisdiction. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

3.2.9 Blowoff Valve Assemblies

Install blowoff valve assemblies as indicated on the drawings or in accordance with the manufacturers recommendations. Install discharge fitting on the end of riser pipe to direct the flow of water so as to minimize damage to surrounding areas.

3.2.10 Fire Hydrants

Install fire hydrants in accordance with NFPA 24 and with the requirements of JDPA T 01 for pipe installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which fire hydrant is attached. Install fire hydrants with the 115 mm connections facing the adjacent paved surface. If there are two paved adjacent surfaces, install fire hydrants with the 115 mm connection facing the paved surface where the connecting main is located.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

Notify the Contracting Officer a minimum of five days in advance of hydrostatic testing. Coordinate the proposed method for disposal of waste water from hydrostatic testing. Perform field tests, and provide labor, equipment, and incidentals required for testing, except that water needed for field tests will be furnished as set forth in paragraph AVAILABILITY AND USE OF UTILITY SERVICES in Section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS. Provide documentation that all items of work have been constructed in accordance with the Contract documents.
3.3.1.1 Hydrostatic Test

Test the water system in accordance with the applicable JWWA standards. Where water mains provide fire service, test in accordance with the special testing requirements given in the paragraph SPECIAL TESTING REQUIREMENTS FOR FIRE SERVICE. Test ductile-iron water mains in accordance with the requirements of JIS S 3200-1 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints is not to exceed the amounts given in pipe manufacturer's installation instructions. No leakage will be allowed at joints made by any other methods. Test PVC and PVCO plastic water systems made with PVC pipe for pressure and leakage tests. The amount of leakage on pipelines made of PVC water main pipe is not to exceed the amounts given in pipe manufacturer's installation instructions, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, flanged joints, and screwed joints. Do not backfill utility trench or begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 7 days after placing of the concrete.

3.3.1.2 Hydrostatic Sewer Test

The hydrostatic pressure sewer test will be performed in accordance with the applicable JWWA standard for the piping material with a minimum test pressure of 200 kPa.

3.3.1.3 Leakage Test

For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

For PE perform leak testing in accordance with the applicable JWWA standards.

3.3.1.4 Bacteriological Testing

Perform bacteriological tests in accordance with the applicable JWWA standards. Analyze samples by a certified laboratory, and submit the results of the bacteriological samples.

3.3.1.5 Backflow Preventer Tests

After installation conduct Backflow Preventer Tests and provide test reports verifying that the installation meets the JIS S 3200-4 or applicable JWWA testing standards.

3.3.1.6 Special Testing Requirements for Fire Service

Test water mains and water service lines providing fire service or water and fire service in accordance with NFPA 24. The additional water added to the system must not exceed the limits given in NFPA 24

3.3.1.7 Tracer Wire Continuity Test

Test tracer wire for continuity after service connections have been completed and prior to final pavement or restoration. Verify that tracer wire is locatable with electronic utility locating equipment. Repair breaks or separations and re-test for continuity.
3.4 SYSTEM STARTUP

Water mains and appurtenances must be completely installed, disinfected, flushed, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Obtain approval by the Contracting Officer prior to the new water piping being placed into service.

3.5 CLEANUP

Upon completion of the installation of water lines and appurtenances, remove all debris and surplus materials resulting from the work.

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SECTION 33 30 00

SANITARY SEWERAGE

05/18

PART 1  GENERAL

1.1  REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5001 (2008) Crushed Stone for Road Construction
JIS A 5005 (2009) Crushed Stone and Manufactured Sand for Concrete
JIS A 5308 (2014) Ready-Mixed Concrete
JIS A 5314 (2014) Mortar Lining for Ductile Iron Pipes
JIS A 5372 (2016) Precast Reinforced Concrete Products
JIS B 1171 (2015) Cup Head Square Neck Bolts (Amendment 1)
JIS B 1180 (2014) Hexagon Head Bolts and Hexagon Head Screws
JIS B 1181 (2014) Hexagon Nuts and Hexagon Thin Nuts
JIS G 3101 (2017) Rolled Steels for General Structure (Amendment 1)
JIS G 5526 (2014) Ductile Iron Pipes
JIS G 5527 (2014) Ductile Iron Fittings
JIS H 8641 (2007) Hot Dip Galvanized Coatings
JIS K 0102 (2019) Testing Methods for Industrial Wastewater (Amendment 1)
JIS K 6353 (2011) Rubber Goods for Water Works
JIS K 6739 (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipe Fittings for Drain
1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Pressure Pipe; G

Sewage Treatment Tanks; G

SD-06 Test Reports

Hydrostatic Sewer Test

Infiltration Tests or Exfiltration Tests

Tests For Pressure Lines; G

Deflection Testing
1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.3.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.3.1.2 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.3.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe in accordance with the manufacturer's recommendation and discard those materials if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of concrete pipe or polyvinyl chloride (PVC) plastic pipe. Provide building connections of polyvinyl chloride (PVC) plastic pipe. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 1.5 m outside of building walls.

2.1.2 Sanitary Sewer Pressure Lines

Provide pressure lines of ductile iron pressure pipe or polyvinyl chloride (PVC) plastic pressure pipe.
2.2 MATERIALS

Provide materials conforming to the respective specifications and other requirements specified below. Submit manufacturer's product specification, standard drawings or catalog cuts.

2.2.1 Gravity Pipe

2.2.1.1 Concrete Gravity Sewer Piping

2.2.1.1.1 Concrete Gravity Pipe

Provide reinforced concrete pipe conforming to JIS A 5372, external pressure type, Class 1 or Class 2, Type B.

2.2.1.1.2 Jointing Materials for Concrete Gravity Piping

Provide gaskets and pipe ends for rubber gasket joint conforming to JIS K 6353. Use gaskets suitable for use with sewage.

Submit certificates of compliance stating that the fittings or gaskets used for waste drains or lines are oil resistant.

2.2.1.2 PVC Gravity Sewer Piping

2.2.1.2.1 Pipe and Fittings

a. Pipe: JIS K 6741, Class VP or VU.

b. Fittings: JIS K 6739

2.2.1.2.2 Joints and Jointing Material

Jointing Materials: Rubber gasket conforming to JIS K 6353. Gaskets shall be suitable for use in sewerage.

2.2.1.2.3 PVC Branch Pipe Connectors

Shall be standard product compatible with the PVC plastic pipe and conforming to JSWAS K-1 and JIS K 6739. Adhesive materials shall be as per branch pipe manufacturer's recommendation.

2.2.2 Pressure Pipe

2.2.2.1 Ductile Iron Pressure Piping

2.2.2.1.1 Ductile Iron Pressure Pipe and Fittings

Provide mechanical joint or flanged ductile-iron pipe conforming to JIS G 5526. Provide fittings conforming to JIS G 5527. Use fittings which have a pressure rating at least equivalent to that of the pipe. Pipe and fittings are to have interior cement-mortar lining conforming to JIS A 5314 and exterior pipe coating conforming to JDPA Z 2010.

2.2.2.1.2 Ductile Iron Pressure Joints and Jointing Materials

a. Joints, general: Use mechanical joints for pipe and fittings. Use flanged joints where indicated. Joints made with sleeve-type mechanical
coupling may be used in lieu of push-on joint.

b. Mechanical joints: Gaskets are to conform to JIS B 2404.

c. Flanged joints: Provide bolts, nuts, and gaskets for flanged connections compatible with JIS G 5527 joints.

d. Joints made with sleeve-type mechanical couplings: Provide bolts conforming to the tensile requirements of JIS B 1180 with nuts conforming to the tensile requirements of JIS B 1181 or round-head square-neck type bolts conforming to JIS B 1171 with hex nuts conforming to JIS B 1181.

2.2.2.2 PVC Pressure Pipe and Associated Fittings

2.2.2.2.1 Pipe and Fittings

Pipe, couplings and fittings are to be manufactured of materials conforming to JIS K 6742 and fittings conforming to JIS K 6743.

2.2.2.2.2 Solvent Cement Joint

Provide solvent cement joint per pipe manufacturer's recommendation.

2.2.3 Piping Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping is to conform to the specifications for pipelines conveying nonflammable substances. For casing pipe provide ductile-iron pipe in lieu of cast-iron soil pipe. Ductile-iron pipe is to conform to and have strength computed in accordance with JIS G 5526.

2.2.4 Portland Cement

Portland cement shall conform to JIS R 5210.

2.2.5 Portland Cement Concrete

Provide portland cement concrete conforming to JIS A 5308, compressive strength of 24 MPa at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement is to have a compressive strength of 18 MPa minimum at 28 days. Protect concrete in place from freezing and moisture loss for 7 days.

2.2.6 Precast Concrete Manholes

Approved commercial products as shown on drawings and conforming to JIS A 5372. Joints between precast concrete manhole sections shall be made with flexible watertight, rubber-type gaskets per manhole manufacturer's standards.

2.2.7 Invert Mortar

Mortar for forming manhole inverts shall be composed of cement, sand and water mixed in proportion of 1 part cement to 2 parts of sand, sufficient water to produce a workable mixture. Mortar shall be used in the work within one hour after mixing.
2.2.8 Gaskets and Connectors

Resilient connectors for making joints between manhole and pipes entering manhole are to conform to pipe manufacturer's standards.

2.2.9 Sewage Treatment Tanks

Shall be three functions of primary, secondary, and final sewage treatment and shall meet the requirements of biochemical oxygen demand (BOD) value as indicated by testing in accordance with JIS K 0102.

2.2.10 Frames And Covers for Manholes

Shall be local manufacturer's standard product conforming to SHASE-S 209, and shall be of cast iron per JIS A 5506. Size, configuration and loading capacity shall be as indicated on drawings. A letter "S" shall be stamped or cast into covers.

2.2.11 Manhole Steps

Materials shall conform to JIS G 3101, Type SS400, galvanized, and of the size and configuration as shown on drawing. Manhole steps are not required in manholes and inlets less than 1.2 m deep.

2.2.12 Manhole Ladders

Provide a steel ladder conforming to JIS G 3101 where the depth of a manhole exceeds 3.6 m. The ladder is not to be less than 406 mm in width, with 19 mm diameter rungs spaced 305 mm apart. The two stringers are to be a minimum 10 mm thick and 51 mm wide. Galvanize ladders and inserts after fabrication in conformance with JIS H 8641.

2.2.13 Miscellaneous Items

2.2.13.1 Warning Tape

Provide in accordance with requirements as specified in Section 31 00 00 EARTHWORK

2.2.13.2 Sand Fill

Fill around PVC drainage pipes shall be cleaned sand conforming to JIS A 5005.

2.2.13.3 Gravel Base Course

Crushed stone for base course at concrete structures shall be crusher run conforming to JIS A 5001, RC-40.

2.2.13.4 Surface Cleanouts

Surface cleanout shall have cast iron cover and fitting adaptable for connection to the lower PVC pipe. Traffic loading capacity shall be as required for the manhole covers located within the same ground surface condition.
PART 3   EXECUTION

3.1   PREPARATION

3.1.1   Installation Drawings

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

3.2   INSTALLATION

Backfill after inspection by the Contracting Officer. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer.

3.2.1   Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.2.2   General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.2.2.1   Location

Terminate the work covered by this section at a point approximately 1.5 m from the building, unless otherwise indicated. Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 0.60 m below bottom of water line. When these separation distances can not be met, contact the Contracting Officer for direction.

3.2.2.1.1   Sanitary Piping Installation Parallel with Water Line

3.2.2.1.1.1   Normal Conditions

Install sanitary piping or manholes at least 3 m horizontally from a water line whenever possible. Measure the distance from edge-to-edge.

3.2.2.1.1.2   Unusual Conditions

When local conditions prevent a horizontal separation of 3 m, the sanitary piping or manhole may be laid closer to a water line provided that:

a. The top (crown) of the sanitary piping is to be at least 450 mm below the bottom (invert) of the water main.

b. Where this vertical separation cannot be obtained, construct the sanitary piping with JWWA-approved ductile iron water pipe pressure and conduct a hydrostatic sewer test without leakage prior to backfilling.

c. The sewer manhole is to be of watertight construction and tested in place.
3.2.2.1.2 Installation of Sanitary Piping Crossing a Water Line

3.2.2.1.2.1 Normal Conditions

Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 450 mm between the top of the sanitary piping and the bottom of the water line whenever possible.

3.2.2.1.2.2 Unusual Conditions

When local conditions prevent a vertical separation described above, use the following construction:

a. Construct sanitary piping passing over or under water lines with JWWA-approved ductile iron water pressure piping and conduct a hydrostatic sewer test without leakage prior to backfilling.

b. Protect sanitary piping passing over water lines by providing:

   (1) A vertical separation of at least 450 mm between the bottom of the sanitary piping and the top of the water line.

   (2) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

   (3) That the length, minimum 6.1 m, of the sanitary piping be centered at the point of the crossing so that joints are equidistant and as far as possible from the water line.

3.2.2.1.3 Sanitary Sewer Manholes

No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.2.2.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK 31 23 00.00 20 EXCAVATION AND FILL.

3.2.2.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 7.50 m apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Construct branch connections by use of regular fittings or with matching branch pipe connectors from the same pipe manufacturer.
3.2.3 Special Requirements

3.2.3.1 Installation of Concrete Gravity Sewer Piping

Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 25 mm of closure, remove the pipe and remake the joint.

3.2.3.2 Installation of Ductile-Iron Pressure Lines

   a. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint. Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions.

   b. Exterior protection: Completely wrap buried ductile iron pipelines with 8 mil (minimum) polyethylene sheet in conformance with JWWA K 158.

   c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to JIS A 5308 having a minimum compressive strength of 18 MPa at 28 days.

3.2.3.3 Installation of PVC Piping

Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.3.4 Installation of PVC Pressure Pipe

3.2.3.4.1 Pipe

Make push-on joints with elastomeric gasket. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel. For push-on joint connections to fittings, use cut spigot end of pipe off square, marked to match the manufacturer's insertion line and beveled to match factory supplied bevel. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of the pipe manufacturer for laying the pipe. Assemble push-on joints for connection to fittings in accordance with the requirements of the pipe manufacturer for joining PVC pipe to fittings and accessories.
3.2.3.4.2 Pipe Anchorage

Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to JIS A 5308 having a minimum compressive strength of 18 MPa at 28 days.

3.2.3.5 Pipeline Installation Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances.

3.2.4 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. Support the pipe on a concrete cradle, or encased in concrete where indicated or directed.

3.2.5 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Perform cast-in-place concrete work in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.2.6 Miscellaneous Construction and Installation

3.2.6.1 Connecting to Existing Manholes

Connect pipe to existing manholes such that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Center the connection on the manhole. Holes for the new pipe are of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that will cause the least damage to the walls.
3.2.6.2 Metal Work

3.2.6.2.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.2.6.2.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal, remove mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2.7 Installations of Wye Branches and Branch Connectors

Install wye branches and branch connectors in an existing sewer using a method which does not damage the integrity of the existing sewer. Do not cut into piping for connections except when approved by the Contracting Officer. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, support on a concrete cradle as directed by the Contracting Officer. Provide and install concrete required because of conditions resulting from faulty construction methods or negligence without any additional cost to the Government. Do not damage the existing sewer when installing wye branches in an existing sewer.

3.2.8 Construction of Sewage Treatment Tanks

Construct sewage tank in accordance with approved drawings and manufacturer's catalog data.

3.3 FIELD QUALITY CONTROL

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.3.1 Tests

Perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section [____].

3.3.1.1 Hydrostatic Sewer Test

When unusual conflicts are encountered between sanitary sewer and waterlines a hydrostatic pressure sewer test will be performed in accordance with the applicable JWWA standard for the piping material with a minimum test pressure of 200 kPa.
3.3.1.2 Leakage Tests for Nonpressure Lines

Test lines for leakage by either infiltration tests or exfiltration tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. When the water table is 60 cm or more above top of pipe at upper end of pipeline section to be tested, measure infiltration using a suitable weir or other acceptable device. When the water table is less than 60 cm above top of pipe at upper end of pipeline section to be tested, make exfiltration test by filling the line to be tested with water so that the head will be at least 1.2 m above top of pipe at upper end of pipeline section being tested. Allow filled pipeline to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, reestablish the head and measure amount of water needed to maintain this water level during a 2-hour test period. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed one liter per cm of diameter per hour per 100 m of pipeline. When leakage exceeds the amount specified, make satisfactory correction and retest pipeline section in the same manner as previously specified. Correct all visible leaks regardless of leakage test results.

3.3.1.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standards as recommended by pipe manufacturer's installation manual for the respective pressure pipes specified in this specification. For hydrostatic pressure test, use a hydrostatic pressure 345 kPa in excess of the maximum working pressure of the system, but not less than 690 kPa, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3.1.4 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads is not to exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

3.3.1.4.1 Pull-Through Device

This device is to be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Space circular sections on the shaft so that the distance from external faces of front and back sections will equal or exceed the diameter of the circular section. Pull-through device may also be of a design recommended by the pipe manufacturer, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections are to conform to the following:

a. A diameter, or minor diameter as applicable, of 95 percent of the
average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

b. Homogeneous material throughout, is to have a density greater than 1.0 as related to water at 4 degrees C, and a surface Brinell hardness of not less than 150.

c. Center bored and through-bolted with a 6 mm minimum diameter steel shaft having a yield strength of not less than 483 MPa, with eyes or loops at each end for attaching pulling cables.

d. Suitably Back each eye or loop with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

3.3.1.4.2 Deflection Measuring Device

Sensitive to 1.0 percent of the diameter of the pipe being tested and be accurate to 1.0 percent of the indicated dimension. Prior approval is required for the deflection measuring device.

3.3.1.4.3 Pull-Through Device Procedure

Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

3.3.1.4.4 Deflection measuring device procedure

Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.3.2 Field Tests for Cast-In-Place Concrete

Field testing requirements are covered in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3.3 Inspection

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; the light must show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.3.3.1 Pre-Installation Inspection

Prior to connecting the new service, perform pre-installation inspection after trenching and layout is complete. Submit pre-installation inspection request for field support at least 14 days in advance. The Installation's Utilities Field Support personnel will perform the pre-installation inspection.

3.3.3.2 Post-Installation Inspection

Perform a post-installation inspection after connection has been made and
before the connection is buried. Submit post-installation inspection request for field support at least 14 days in advance. The Installation's Utilities Field Support personnel will perform the post-connection inspection.

-- End of Section --
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DIVISION 33 - UTILITIES

SECTION 33 40 00

STORM DRAINAGE UTILITIES

02/10

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PART 1   GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 1210  (2009) Test Method for Soil Compaction Using a Rammer
JIS A 5001  (2008) Crushed Stone for Road Construction
JIS A 5005  (2009) Crushed Stone and Manufactured Sand for Concrete
JIS A 5308  (2014) Ready-Mixed Concrete
JIS A 5372  (2016) Precast Reinforced Concrete Products
JIS G 3101  (2017) Rolled Steels for General Structure (Amendment 1)
JIS H 8641  (2007) Hot Dip Galvanized Coatings
JIS K 6353  (2011) Rubber Goods for Water Works
JIS K 6739  (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipe Fittings for Drain
JIS K 6741  (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipes
JIS K 6761  (2017) Polyethylene Pipes for General Purposes

JAPAN SEWERAGE WORKS ASSOCIATION STANDARDS (JSWAS)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates
Crushed Stone for Perforated Pipes
Geotextile Filter Fabric for Perforated Pipes
Leakage Test; G
Determination of Density
Post-Installation Inspection Report; G

SD-08 Manufacturer's Instructions
Placing Pipe

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.
shall conform to the requirements specified.

2.1.1 Concrete Pipe

Provide reinforced concrete pipe conforming to JIS A 5372, external pressure type, Class 1 or 2, Type B. Provide gaskets and pipe ends for rubber gasket joint conforming to JIS K 6353. Use gaskets suitable for use with sewage.

2.1.2 Precast Concrete Pipe-Type Gutter

Japanese manufactured precast concrete product that comes in standard length of 2 m. Locally known as DO pipe or acceptable alternative, and to be used along curb lines to function as gutter with water conveyance underneath. Shall be of the cross section shown on drawing and panels are supplied both with grating and without grating. Traffic loading capacity shall be 25 tons. Jointing materials shall be in accordance with manufacturer's standards.

2.1.3 Precast Concrete Pipe Culvert Type Ditch

Japanese manufactured precast concrete product that comes in standard length of 2 m. Locally known as DO pipe or acceptable alternative, and to be used for below grade construction in place of PVC pipe whenever the sand fill layer above the PVC pipe is less than 300 mm. Shall be of the cross section shown on drawing and to be installed where specified on drainage plans. Traffic loading capacity shall be 25 tons. Jointing materials shall be in accordance with manufacturer's standards.

2.1.4 Polyvinyl Chloride (PVC) Pipe

a. PVC plastic pipe shall be in conformance with JIS K 6741, Type VP or VU.

b. Fitting for PVC plastic pipe shall be in conformance with JIS K 6739.

c. Jointing material for PVC plastic pipe shall be in conformance with PVC pipe manufacturer's recommendation.

d. PVC branch pipe connectors shall be standard product compatible with the PVC plastic pipe and conforming to JISWAS K-1 and JIS K 6739. Adhesive materials shall be per branch pipe manufacturer's recommendation.

2.1.5 Polyethylene (PE) Pipe

a. Polyethylene pipe shall be in conformance with JIS K 6761.

b. Jointing material shall conform with polyethylene pipe manufacturer's recommendation.

2.2 PERFORATED PIPING

2.2.1 Polyvinyl Chloride (PVC) Pipe

a. Perforated PVC plastic pipe shall be in conformance with JIS K 6741, Type VP or VU.

b. Fitting for perforated PVC plastic pipe shall be in conformance with
c. Jointing material for perforated PVC plastic pipe shall be in conformance with PVC pipe manufacturer's recommendation.

2.2.2 Polyethylene (PE) Pipe

a. Flexible perforated polyethylene pipe shall be in conformance with JIS K 6761.

b. Jointing material shall conform with polyethylene pipe manufacturer's recommendation.

2.3 OTHER DRAINAGE CONVEYANCE MATERIALS

2.3.1 Precast Concrete Free Gradient Ditch

Manufactured precast concrete product that comes in standard length of 2 m, and to be used as an interceptor trench along curb lines. Typically of inverted U shaped with the flat top functioning as gutter surface with grated inlets while the bottom is open and filled with plain concrete to obtain the desired gradient of the water conveyance underneath. Shall be of the varying cross sections as shown on drawing. Traffic loading capacity shall be 25 tons. Jointing materials shall be in accordance with manufacturer's standards.

2.3.2 Precast Concrete U-Ditch

Manufactured precast concrete product conforming to JIS A 5372. Comes in 600 mm panel length and shall be of the cross section shown on drawing. Ditch shall be non-traffic type and with or without cover where specified on drawing.

2.3.3 Cast-in-Place Concrete Trench

A reinforced concrete trench of varying cross sections as shown on drawing. Concrete in conformance with JIS A 5308 shall be 24 MPa and shall have frame and grating.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Concrete

Reinforced concrete drainage structures shall use concrete with compressive strength of 24 MPa.

2.4.2 Leveling Mortar

Mortar for setting precast concrete pipe type gutter and culvert pipe ditch (both locally known as DO pipe) shall composed of cement, sand and water mixed in proportion of 1 part cement to 3 parts of sand, sufficient water to produce a workable mixture. Mortar shall be used in the work within one hour after mixing.

2.4.3 Leveling Concrete and Concrete Fill

Plain concrete to be used where specified on drainage drawing details shall have a compressive strength of 18 MPa.
2.4.4 Precast Reinforced Concrete Manholes

Approved commercial products as shown on drawings and conforming to JIS A 5372. Joints between precast concrete manhole sections shall be made with flexible watertight, rubber-type gaskets per manhole manufacturer's standards.

2.4.5 Frames, Covers And Grating

2.4.5.1 Manhole Frames and Covers

Shall be Japanese manufacturer's standard product conforming to SHASE-S 209, and shall be of cast iron per JIS A 5506. Size, configuration and loading capacity shall be as indicated on drawings. A letter "D" shall be stamped or cast into covers.

2.4.5.2 Ditch and Inlet Frame and Grating

Shall be Japanese manufacturer's standard product of steel materials and of the size, shape, grating pattern, and loading capacity as indicated on drawings. Grating shall be finished with factory-zinc-coated in accordance with JIS H 8641, and frame shall be finished with factory-bake coated.

2.4.6 Sand Fill And Leveling Sand

Fill around PVC drainage pipes and for setting non-traffic type precast U-ditch shall be clean sand conforming to JIS A 5005.

2.4.7 Crushed Stone For Perforated Pipes

Granular aggregates for use in perforated pipes shall be single-sized crushed stone S-20 (#5) of size 13 mm to 20 mm and conforming to JIS A 5001.

2.4.8 Gravel Base Course

Crushed stone for base course at concrete structures shall be crusher run conforming to JIS A 5001, RC-40.

2.4.9 Flap Gates

Flap Gates shall be medium or heavy-duty with circular or rectangular opening and double-hinged. Top pivot points shall be adjustable. The seat shall be one-piece cast iron with a raised section around the perimeter of the waterway opening to provide the seating face. The seating face of the seat shall be cast iron or stainless steel. The cover shall be one-piece cast iron with necessary reinforcing rib, lifting eye for manual operation, and bosses to provide a pivot point connection with the links. The seating face of the cover shall be cast iron or stainless steel. Links or hinge arms shall be cast or ductile iron. Holes of pivot points shall be bronze bushed. All fasteners shall be either galvanized steel, bronze or stainless steel.

2.5 STEEL LADDER

Steel ladder conforming to JIS G 3101 shall be provided where the depth of the storm drainage structure exceeds 3.66 m. These ladders shall be not less than 406 mm in width, with 19 mm diameter rungs spaced 305 mm apart. The two stringers shall be a minimum 10 mm thick and 63 mm wide. Ladders and inserts shall be galvanized after fabrication in conformance with
2.5.1 Manhole Steps

Materials shall conform to JIS G 3101, Type SS 400, galvanized, and of the size and configuration as shown on drawing. Manhole steps are not required in manholes and inlets less than 1.2 m deep.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to pipe manufacturer's standards.

2.7 GEOTEXTILE FILTER FABRIC FOR PERFORATED PIPES

Submit certification from the manufacturers attesting that the filter fabric meets specification requirements. Provide geotextile that is a nonwoven pervious sheet of polymeric material conforming to JIS L 1908.

2.8 Warning Tape

Provide in accordance with requirements as specified in Section 31 00 00 EARTHWORK.

2.9 Cleanouts

Cleanouts installed at vertical PVC downspouts shall use the standard Y-fitting with the compatible PVC cleanout cover conforming to JIS K 6739. Surface cleanout at paved and turfed areas shall be cast iron cover and fitting adaptable for connection to the lower PVC pipe. Traffic loading capacity for surface cleanout shall be as required for manhole covers located within the same ground surface condition.

2.10 EROSION CONTROL RIP RAP

Provide non-erodible rock not exceeding 375 mm in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of [200 mm] [as indicated].

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK, 31 23 00.00 20 EXCAVATION AND FILL and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 500 mm to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet ing and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.
3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 200 mm or 13 mm for each meter of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK 31 23 00.00 20 EXCAVATION AND FILL.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

Concrete pipe shall be bedded with sand material minimum 200 mm in depth in trenches with soil foundation. Depth of sand bedding in trenches with rock foundation shall be 13 mm in depth per 300 mm of depth of fill, minimum depth of bedding shall be 200 mm up to maximum depth of 600 mm. Where concrete pipes are laid in deep trenches or where traffic loads are expected, the entire pipe line length shall be supported uniformly by concrete foundation or cradle.

3.2.2 Precast, Concrete Pipe Type Gutter/Ditch and Free-Gradient Ditch

These type of Precast drainage materials shall be laid using leveling mortar over a concrete foundation base.

3.2.3 Precast Concrete U-Ditch

Use leveling sand for non-traffic areas and leveling mortar over concrete foundation for traffic areas.

3.2.4 Plastic Pipe

Use clean sand for bedding, haunching and initial backfill for PVC and PE pipes. Minimum depth of bedding shall be 200 mm.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from
exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed 4.5 percent of the average inside diameter of pipe.

3.3.1 Concrete and Plastic Pipes

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe pointing in the direction of the flow.

3.3.2 Precast Concrete Pipe Type Gutter/Ditch, Free Gradient Ditch and U-Ditch

Lay the drainage materials in conformance with product manufacturer's instructions.

3.3.3 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter apart, whichever is less.

3.4 JOINING

3.4.1 Concrete Pipes and Other Precast Concrete Drainage Conveyance Materials.

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer. Cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.2 Plastic Piping

Install pipes and fittings per pipe manufacturer's installation manual.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, precast reinforced concrete, precast concrete segmental blocks complete with frames and covers or gratings; and with fixed galvanized steel ladders or manhole steps where indicated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors in conformance with pipe manufacturer.
3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 Metal Steps

Individual metal steps shall be adequately anchored to precast manhole walls per manhole or metal step manufacturer's installation standards.

3.7 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 1.83 m vertically, and shall be installed to provide at least 152 mm of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.8 BACKFILLING

3.8.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded clean sand shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 300 mm above the top of the pipe. The remainder of the trench shall be backfilled with select material from excavation or borrow and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 150 mm. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.8.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 150 mm in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping orramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 300 mm above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 4 m, whichever is less. After the backfill has reached at least 300 mm above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 150 mm. Use sand material for this entire region of backfill for flexible and concrete pipe installations.

3.8.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.
3.8.4 Compaction

3.8.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.8.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.9 FIELD PAINTING

3.9.1 Cast-Iron Covers and Frames

After installation, clean cast-iron, not buried in masonry or concrete, of mortar, rust, grease, dirt, and other deleterious materials to bare metal and apply a coat of bituminous paint.

3.10 FIELD QUALITY CONTROL

3.10.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.10.1.1 Leakage Test

Lines shall be tested for leakage by exfiltration tests prior to completing backfill. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be
measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 9 mL per mm in diameter per 100 meters of pipeline per hour.

3.10.1.2 Determination Of Density

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with JIS A 1210 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with JIS A 1214.

3.10.1.3 Deflection Testing

Conduct deflection test no sooner than 30 days after completion of final backfill and compaction testing. Clean or flush all lines prior to testing. Perform a deflection test on entire length of installed flexible pipeline upon completion of work adjacent to and over the pipeline, including backfilling, placement of fill, grading, paving, placement of concrete, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Use a laser profiler or mandrel to determine if allowable deflection has been exceeded.

3.10.1.3.1 Laser Profiler

Inspect pipe interior with laser profiling equipment. Utilize low barrel distortion video equipment for pipe sizes 1.22 m or less. Use a camera with suitable lighting to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally. The camera must be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 1.22 m, a visual inspection shall be completed of the pipe interior.

3.10.1.3.2 Mandrel

Pass the mandrel through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, stop and begin test from the opposite direction. The mandrel must meet the Pipe Manufacture's recommendations and the following requirements. Provide a Mandrel that is rigid, nonadjustable, has a minimum of 9 fins, pulling rings at each end, and is
engraved with the nominal pipe size and mandrel outside diameter. The mandrel must be 4.5 percent less than the certified-actual pipe diameter for Plastic Pipe. The Government will verify the outside diameter (OD) of the Contractor provided mandrel through the use of Contractor provided proving rings.

3.10.2 Inspection

3.10.2.1 Post-Installation Inspection

Visually inspect each segment of concrete pipe for alignment, settlement, joint separations, soil migration through the joint, cracks, buckling, bulging and deflection. An engineer must evaluate all defects to determine if any remediation or repair is required.

3.10.2.1.1 Concrete

Cracks with a width greater than 0.25 mm. An engineer must evaluate all pipes with cracks with a width greater than 0.25 mm but less than 2.5 mm to determine if any remediation or repair is required.

3.10.2.1.2 Flexible Pipe

Check each flexible pipe (PE, PVC) for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

3.10.2.1.3 Post-Installation Inspection Report

The deflection results and final post installation inspection report must include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.10.3 Repair Of Defects

3.10.3.1 Leakage Test

When leakage exceeds the maximum amount specified, correct source of excess leakage by replacing damaged pipe and gaskets and retest.

3.10.3.2 Deflection Testing

When deflection readings are in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection and replace with new pipe. Retest 30 days after completing backfill, leakage testing and compaction testing.

3.10.3.3 Inspection

Replace pipe or repair defects indicated in the Post-Installation Inspection Report.

3.10.3.3.1 Concrete

Replace pipes having cracks with a width greater than 2.5 mm.
3.10.3.3.2 Flexible Pipe

Replace pipes having cracks or splits.

3.11 PROTECTION

Protect storm drainage piping and adjacent areas from superimposed and external loads during construction.

3.12 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

-- End of Section --
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1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS), Ministry of Land, Infrastructure and Transport (MLIT), Japan Electrical Safety Inspection Associations or Japan Power Cable Accessories Association (JCAA) standards for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)


JAPANESE ELECTROTECHNICAL COMMITTEE (JEC)

JEC 3408  (2015) High voltage test of extra high voltage (11 kV to 500 kV) cross-linked polyethylene cable and connections

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS A 5372  (2016) Precast Reinforced Concrete Products
JIS C 2336  (2012) Pressure-sensitive polyvinyl chloride tapes for electrical purposes
JIS C 2338  (2012) Polyester adhesive tape for electrical insulation
JIS C 2805  (2010) Crimp terminal for copper wire
JIS C 2806  (2003) Bare crimping sleeve for copper wire
JIS C 2810  (1995) General rules on non-separable type wire connectors for interior wiring
JIS C 3101  (1994) Hard-drawn copper wires for electrical purposes
JIS C 3105 (1994) Hard-drawn copper stranded conductors
JIS C 3108 (2016) Hard-drawn aluminium wires for electric purposes
JIS C 3109 (1994) Hard-drawn aluminium stranded conductors
JIS C 3341 (2000) Polyvinyl chloride insulated drop service wires
JIS C 3362 (2009) 600 V Cross-linked polyethylene insulated cables
JIS C 3367 (2008) Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV -- Cables for rated voltages of 0.6/1 kV
JIS C 3605 (R2002) 600 V Polyethylene Insulated Cables, Type CV
JIS C 3606 (R2003) High-Voltage Cross-Linked Polyethylene Insulated Cables, Type CV or CE
JIS C 3612 (2002) 600V Flame Retardant Polyethylene Insulated Wires
JIS C 3653 (2004) Installation methods of power cables buried ground
JIS C 8305 (2019) Rigid Steel Conduits
JIS C 8330 (1999) Fittings for rigid metal conduits
JIS C 8340 (1999) Boxes And Box Covers For Rigid Metal Conduits
JIS C 8350 (1999) Fittings for pliable metal conduits
JIS C 8380 (1993) Plastic coated steel pipes for cable-ways
JIS C 8430 (2019) Unplasticized polyvinyl chloride (PVC-U) conduits
JIS C 8432 (2019) Fittings of unplasticized polyvinyl chloride (PVC-U) conduits
JIS C 60364-6 (2010) Low-voltage electrical
installations -- Part 6: Verification

JIS C 60695-2-4-0 (1995) Fire hazard testing Part 2: Test methods -- Section 4/sheet 0: Diffusion type and premixed type flame test methods

JIS K 6741 (2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipes


JAPAN ELECTRICAL SAFETY INSPECTION ASSOCIATIONS

Denki Hoan Kyoukai Japan Standard for Acceptance Testing and Inspections

JAPAN POWER CABLE ACCESSORIES ASSOCIATION STANDARDS

JCAA A 202 (1989) Indoor / outdoor termination connection for 3300V cross-linked polyethylene insulated power cable

JCAA A 203 (1992) Straight connection for 3300V cross-linked polyethylene insulated power cable

JCAA A 302 (1992) Indoor termination connection for 6600V cross-linked polyethylene insulated power cable

JCAA A 303 (1992) Outdoor termination connection for 6600V cross-linked polyethylene insulated power cable

JCAA A 305 (1992) Straight connection for 6600 V cross-linked polyethylene insulated power cable

JCAA A 501 (1988) Indoor termination connection for 22kV 33kV cross-linked polyethylene insulated power cable

JCAA A 502 (1988) Outdoor termination connection for 22kV 33kV cross-linked polyethylene insulated power cable

JCAA A 503 (1988) Straight connection for 22kV and 33kV cross-linked polyethylene insulated power cable

JAPAN WIRE INDUSTRY ASSOCIATION STANDARD (JCS)

JCS 0168-4 (2010) Calculation of allowable current for power cables under 33 kV-- Part 4: Allowable current for 22 kV, 33 kV crosslinked polyethylene cables

JCS 0501 (2014) Allowable current calculation for
[1.2 SYSTEM DESCRIPTION]

Items provided under this section must be specifically suitable for the following service conditions. Seismic details must [conform to UFC 3-310-04, "Seismic Design for Buildings" and Sections 13 48 00 [SEISMIC] BRACING FOR MISCELLANEOUS EQUIPMENT and 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT] [be as indicated].

a. Fungus Control [_____]
b. Altitude [_____] m.
c. Ambient Temperature [_____] degrees C.
d. Frequency [_____]
e. Ventilation [_____]
f. Seismic Parameters [_____]
g. Humidity Control [_____]
h. Corrosive Areas [_____]
i. [_____]

[1.3 RELATED REQUIREMENTS]

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.
1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. Japan voltage range categories are defined as follows:
   - Low Voltage (Voltages less than 1kV)
   - High Voltage (Voltages 1kV thru 7kV)
   - Extra High Voltage (Voltages over 7kV)

d. In the text of this section, "[High][Extra-High] voltage cable splices," and "[High][Extra-High] voltage cable joints" are used interchangeably and have the same meaning.

[ d. Underground structures subject to aircraft loading are indicated on the drawings.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Precast underground structures; G[, [______]]

SD-03 Product Data
   [High][Extra-High] voltage cable; G[, [______]]
   [High][Extra-High] voltage cable joints; G[, [______]]
   [High][Extra-High] voltage cable terminations; G[, [______]]
   Live end caps; G[, [______]]
   Precast concrete structures; G[, [______]]

Sealing Material
   Pulling-In Irons
   Manhole frames and covers; G[, [______]]
   Handhole frames and covers; G[, [______]]
   Frames and Covers for Airfield Facilities; G[, [______]]
   Ductile Iron Frames and Covers for Airfield Facilities; G[, [______]]
Composite/fiberglass handholes; G[, [______]]

Cable supports (racks, arms and insulators); G[, [______]]

Protective Devices and Coordination Study; G[, [______]]

The study must be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed must be based on recommendations of this study. The Government must not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered or procured prior to approval of the study.

SD-06 Test Reports

Field Acceptance Checks and Tests;

1.6 QUALITY ASSURANCE

1.6.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f′c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with Manufacturer's recommendations.

e. Plans and elevations showing opening and pulling-in iron locations and details

1.6.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of IEEE C2 and JIS C 0365 unless more stringent requirements are specified or indicated.

1.6.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period must include applications of equipment and materials under similar
circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit or Type G

JIS C 8305, Type G. Diameter of conduit shall be as indicated.

2.1.1.1 Rigid Metallic Conduit, PVC Coated or Type G; LL or LT

JIS C 8380, Type G; LL or LT.

2.1.2 Intermediate Metal Conduit or Type C

JIS C 8305, Type C.

2.1.2.1 Intermediate Metal Conduit, PVC Coated or Type C; LL or LT

JIS C 8380, Type C; LL or LT.

2.1.3 Plastic Conduit or Unplasticized Polyvinyl Chloride for Direct Burial and Riser Applications

[As indicated] [JIS C 3653, Type FEP] [or] JIS C 8430 for Type HIVE conduit of diameter of less than 100mm and JIS K 6741 for Type HIVP conduit diameter of 100mm and larger.

2.1.4 Plastic Duct or Unplasticized Polyvinyl Chloride for Concrete Encasement

Provide[ as indicated][ or JIS C 8430 for Type VE conduit of diameter of less than 100mm and JIS K 6741 for Type VP conduit diameter of 100mm and larger].

2.1.5 Innerduct

Provide corrugated [or solid wall] polyethylene (PE) or PVC innerducts, or fabric-mesh innerducts, with pullwire. Size as indicated.
2.1.6 Duct Sealant

UL 94 and JIS C 60695-2-4-0. Provide high-expansion urethane foam duct sealant that expands and hardens to form a closed, chemically and water resistant, rigid structure. Sealant must be compatible with common cable and wire jackets and capable of adhering to metals, plastics and concrete. Sealant must be capable of curing in temperature ranges of 2 degrees C to 35 degrees C. Cured sealant must withstand temperature ranges of -29 degrees C to 93 degrees C without loss of function.

2.1.7 Fittings

2.1.7.1 Metal Fittings

JIS C 8330 and JIS C 8350.

2.1.7.2 PVC or Unplasticized Polyvinyl Chloride Conduit Fittings

[JIS C 8432 for diameters less than 100mm][JIS K 6743 for diameters 100mm or larger].

[2.1.7.3 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit must be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and must conform to JIS C 8340.

2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors must be rated 600 volts and conform to the requirements of applicable codes and standards, including listing requirements[, or in accordance with JIS C 3362 or JIS C 3367]. Wires and cables manufactured more than [24][12] months prior to date of delivery to the site are not acceptable. Service entrance conductors must conform to JIS C 3341.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and [THHN/THWN][EM-IE][EM-CE] unless otherwise noted. Conductors 5.5 sqmm and smaller must be solid. Conductors 8 sqmm and larger must be stranded.[ Conductor 14 sqmm and smaller must be copper. Conductors 22 sqmm and larger may be either copper or aluminum, at the Contractor's option. Do not substitute aluminum for copper if the equivalent aluminum conductor size would exceed 250 sqmm. When the Contractor chooses to use aluminum for conductors 22 sqmm and larger, the Contractor must: increase the conductor size to have the same ampacity as the copper size indicated; increase the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with applicable codes and standards; ensure that the pulling tension rating of the aluminum conductor is sufficient; relocate equipment, modify equipment terminations, resize equipment, and resolve to the satisfaction of the Contracting Officer problems that are direct results of the use of aluminum conductors in lieu of copper.][ All conductors must be copper.]

2.2.2 Conductor Material

Unless specified or indicated otherwise or required, wires in conduit, other than service entrance, must be 600-volt,conforming to [Type EM-IE
Copper conductors must be annealed copper complying with JCS 1226 and JIS C 3102 and JIS C 3105. Aluminum conductors must be Type AA-8000 aluminum conductors complying with JIS C 3108 and JIS C 3109, and must be of an aluminum alloy listed or labeled by UL as "component aluminum-wire stock (conductor material)." Type 1350 is not acceptable. Intermixing of copper and aluminum conductors in the same raceway is not permitted.

[2.2.3] Jackets

Multiconductor cables must have an overall PVC outer jacket.

[2.2.4] Direct Buried

Single-conductor [and multi-conductor] cables must be of a type identified for direct burial.

[2.2.5] In Duct

Cables must be single-conductor cable. [Cables in factory-installed, coilable-plastic-duct assemblies where extra physical protection is required.]

[2.2.6] Cable Marking

Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Identify each cable by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag must contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Conductors must be color coded. Provide conductor identification within each enclosure where a tap, splice, or termination is made. Conductor identification must be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves, or colored electrical tape. Control circuit terminations must be properly identified. Color must be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals must be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems must be as follows:

a. Three-phase - Primary
   (1) Phase A - red
   (2) Phase B - white
   (3) Phase C - blue
b. Three-phase - Secondary
   (1) Phase A - red
   (2) Phase B - black
(3) Phase C - blue

(1) Phase A - brown
(2) Phase B - orange

(3) Phase C - yellow

d. Single phase: Black and red

[ d. On three-phase, four-wire delta system, high leg must be orange, as required.

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Must provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: JIS C 2805, JIS C 2806 and JIS C 2810.

[ b. For use with aluminum conductors: JIS C 2805, JIS C 2806 and JIS C 2810. For connecting aluminum to copper, connectors must be the circumferentially compressed, metallurgically bonded type.

2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water.

2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material applied in accordance with the manufacturer's written instructions.

2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation must not require heat or flame, or any additional materials such as covering or adhesive. It must be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.5 [HIGH][EXTRA-HIGH] VOLTAGE CABLE

Cable (conductor) sizes are designated by millimeters (mm) and square milimeters (sqmm). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than [24][12] months prior to date of delivery to the site are not acceptable. Provide single conductor type cables unless otherwise indicated.
2.5.1 Cable Configuration

Provide [Type CVT, conforming to JCS 4516 for 3.3kV][Type EM-CET, conforming to JIS C 3606 for 6.6kV][ or ][Type EM-CET, conforming to JCS 0168-4 for 22kV and 33kV][Type CV-CVT, conforming to JCS 0501 for 66kV and 77kV]. [Concentric neutral underground distribution cable][Metallic armored cables, consisting of three-conductor, multi-conductor cables, with insulation and shielding, as specified, using [a galvanized steel][an aluminum] interlocked tape armor and thermoplastic jacket]. Provide cables manufactured for use in [duct][ or ][direct burial] applications [as indicated]. Cable must be rated [3.3kV][5 kV][6.6kV][15 kV][22kV][25 kV][28 kV][33kV][35 kV][66kV][77kV][as indicated] with [[100][133] percent insulation level][[ insulation resistance].

2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B [compact round] conductors. Provide [aluminum alloy conductors complying with JIS C 3108 and JIS C 3109][aluminum alloy cables, 3/4 hard minimum for regular concentric and compressed stranding or for compacted stranding][soft drawn copper cables complying with JCS 1226 and JIS C 3102 and JIS C 3105 for regular concentric and compressed stranding or JIS C 3606 for compact stranding].

2.5.3 Insulation

Provide [ethylene-propylene-rubber (EPR) insulation][tree-retardant cross-linked thermosetting polyethylene (XLP) insulation].

2.5.4 Shielding

Cables rated for 2 kV and above must have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper [tape][ or ][wire] shield for each phase.

2.5.5 Neutrals

[Neutral conductors must be [copper][aluminum], employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.][Concentric neutrals conductors must be copper, having a combined ampacity [equal to][1/3 of] the phase conductor ampacity rating.][ For high impedance grounded neutral systems, the neutral conductors from the neutral point of the transformer or generator to the connection point at the impedance must utilize [copper][aluminum] conductors, employing the same insulation level and construction as the phase conductors.]

2.5.6 Jackets

Provide cables with a [PVC][_____] jacket. [Direct buried cables must be rated for direct burial.][Provide type UD cables with an overall jacket.][Provide PVC jackets with a separator that prevents contact with underlying semiconducting insulating shield.]

2.6 [HIGH][EXTRA-HIGH] VOLTAGE CABLE TERMINATIONS

Provide indoor terminator/outdoor terminations with skirts. [JCAA A 202 for 3.3kV][JCAA A 302 and JCAA A 303 for 6.6kV][JCAA A 501 and JCAA A 502 for 22kV and 33kV][JEC 3408 for 66kV and 77kV]; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable
elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations, where required, must be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Terminations must be provided in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations must be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator must be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination must not require heat or flame for installation. Termination kit must contain all necessary materials (except for the lugs). Termination must be designed for installation in low or highly contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator must consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Termination must be designed for installation in low or highly contaminated indoor or outdoor locations.

[2.6.3 Separable Insulated Connector Type

Produce connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points. Separable connectors must not be used in manholes/handholes.

[ a. 200 Ampere loadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Short time rating: 10,000 rms symmetrical amperes.
]
[ b. 600 Ampere deadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Short time rating: 25,000 rms symmetrical amperes.[ Connectors must have 200 ampere bushing interface[ for surge arresters][ as indicated].]
]
]
[ d. Install one set of faulted circuit indicators on the test points of each set of separable insulated connectors. Indicators must be self powered; with automatic trip with mechanical flag indication upon

SECTION 33 71 02 Page 16
2.7 [HIGH][EXTRA-HIGH] VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with [JCAA A 203 for 3.3kV][JCAA A 305 for 6.6kV][JCAA A 503 for 22kV and 33 kV][JEC 3408 for 66kV and 77kV] suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints must be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with [JCAA A 203 for 3.3kV][JCAA A 305 for 6.6kV][JCAA A 503 for 22kV and 33 kV][JEC 3408 for 66kV and 77kV]. Connectors for joint must be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 Heat-Shrinkable Joint

Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.

2.7.2 Cold-Shrink Rubber-Type Joint

Joint must be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket must be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice must be packaged three splices per kit, including complete installation instructions.

2.8 TELECOMMUNICATIONS CABLES

Provide telecommunications cabling in accordance with Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.9 LIVE END CAPS

Provide live end caps using a "kit" including a heat-shrinkable tube and a high dielectric strength, polymeric plug overlapping the conductor. End cap must conform to applicable portions of [JCAA A 202 for 3.3kV][JCAA A 302 and JCAA A 303 for 6.6kV][JCAA A 501 and JCAA A 502 for 22kV and 33kV][JEC 3408 for 66kV and 77kV].

2.10 TAPE

2.10.1 Insulating Tape

JIS C 2336 and JIS C 2338, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.10.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section [31 23 00.00 20 EXCAVATION AND FILL][31 00 00 EARTHWORK].
2.10.3 Fireproofing Tape

Provide tape composed of a flexible, conformable, unsupported intumescent elastomer. Tape must be not less than 0.762 mm thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, adhesive-free, and must not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.11 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 890 N.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Provide [copper-clad steel ground rods conforming to JIS C 60364-5-54][solid copper ground rods conforming to JIS C 60364-5-54][solid stainless steel ground rods] not less than [19 mm] in diameter by [3.1 m] in length. Sectional type rods may be used for rods 6 meters or longer.

2.12.2 Grounding Conductors

Stranded-bare copper conductors must conform to JIS C 3105 soft-drawn unless otherwise indicated. Solid-bare copper conductors must conform to JIS C 3101 for sizes 8 sqmm and smaller. Insulated conductors must be of the same material as phase conductors and green color-coded, except that conductors must be rated no more than 600 volts. Aluminum is not acceptable.

2.13 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 20 MPa minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts must be 30 MPa minimum 28-day compressive strength unless specified otherwise.

2.14 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to JIS A 5372. Top, walls, and bottom must consist of reinforced concrete. Walls and bottom must be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers must fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, must be adequate to accommodate the cable.

2.14.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE. Construct walls on a footing of cast-in-place concrete except that precast
concrete base sections may be used for precast concrete manhole risers.] [Concrete block must conform to Section 04 20 00, MASONRY.] [Concrete block is not allowed in areas subject to aircraft loading.]

2.14.2 Precast Concrete Structures, Risers and Tops

Precast concrete underground structures may be provided in lieu of cast-in-place subject to the requirements specified below. Precast units must be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.14.2.1 General

Precast concrete structures must have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures must have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction must be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work must have a 28-day compressive strength of not less than 30 MPa. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures must be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.14.2.2 Design for Precast Structures

In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

a. Angle of Internal Friction (phi) = 0.523 rad

b. Unit Weight of Soil (Dry) = 1760 kg/m³, (Saturated) = 2080 kg/m³

c. Coefficient of Lateral Earth Pressure (Ka) = 0.33

d. Ground Water Level = 915 mm below ground elevation

e. Vertical design loads must include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads must consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load must be for H20 highway loading.

f. Horizontal design loads must include full geostatic and hydrostatic pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, must be considered, along with a pulling-in iron design load of 26,700 N.

g. Each structural component must be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.
h. Design must also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.14.2.3 Construction

Structure top, bottom, and wall must be of a uniform thickness of not less than 150 mm. Thin-walled knock-out panels for designed or future duct bank entrances are not permitted. Provide quantity, size, and location of duct bank entrance windows as directed, and cast completely open by the precaster. Size of windows must exceed the nominal duct bank envelope dimensions by at least 305 mm vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows must be a minimum of 150 mm from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 13 bars around window openings. Provide drain sumps a minimum of 305 mm in diameter and 100 mm deep for precast structures.

2.14.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.14.3 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to SHASE-S 209 and JIS A 5506. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.14.4 Handhole Frames and Covers

Frames and covers of steel must be welded by qualified welders in accordance with standard commercial practice. Steel covers must be rolled-steel floor plate having an approved antislip surface. Hinges must be of [stainless steel with bronze hinge pin] [wrought steel], 125 by 125 mm by approximately 4.75 mm thick, without screw holes, and must be for full surface application by fillet welding. Hinges must have nonremovable pins and five knuckles. The surfaces of plates under hinges must be true after the removal of raised antislip surface, by grinding or other approved method.

2.14.5 Frames and Covers for Airfield Facilities

Fabricate frames and covers for airfield use of standard commercial grade steel welded by qualified welders. Covers must be of rolled steel floor plate having an approved anti-slip surface. Steel frames and covers must be hot dipped galvanized after fabrication.
2.14.6 Ductile Iron Frames and Covers for Airfield Facilities

At the contractor's option, ductile iron covers and frames designed for a minimum proof load of 45,000 kg may be provided in lieu of the steel frames and covers indicated. Covers must be of the same material as the frames (i.e., ductile iron frame with ductile iron cover, galvanized steel frame with galvanized steel cover). Perform proof loading in accordance with applicable codes and standards. Proof loads must be physically stamped into the cover. Provide the Contracting Officer copies of previous proof load test results performed on the same frames and covers as proposed for this contract. Modify the top of the structure to accept the ductile iron structure in lieu of the steel structure indicated. The finished structure must be level and non-rocking, with the top flush with the surrounding pavement.

2.14.7 Brick for Manhole Collar

Provide sewer and manhole brick as required per applicable codes and standards.

2.14.8 Composite/Fiberglass Handholes and Covers

Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass with a design load (Tier rating) appropriate for or greater than the intended use. All covers are required to have the Tier level rating embossed on the surface and this rating must not exceed the design load of the box.

2.15 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

The metal portion of racks and arms must be zinc-coated after fabrication.

2.15.1 Cable Rack Stanchions

The wall bracket or stanchion must be 100 mm by approximately 38 mm by 4.76 mm channel steel, or 100 mm by approximately 25 mm glass-reinforced nylon with recessed bolt mounting holes, 1220 mm long (minimum) in manholes. Slots for mounting cable rack arms must be spaced at 200 mm intervals.

2.15.2 Rack Arms

Cable rack arms must be steel or malleable iron or glass reinforced nylon and must be of the removable type. Rack arm length must be a minimum of 200 mm and a maximum of 305 mm.

2.15.3 Insulators

Insulators for metal rack arms must be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.16 CABLE TAGS IN MANHOLES

Provide tags for each power cable located in manholes. The tags must be polyethylene. Do not provide handwritten letters. The first position on the power cable tag must denote the voltage. The second through sixth positions on the tag must identify the circuit. The next to last position must denote the phase of the circuit and include the Greek "phi" symbol. The last position must denote the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A) 500," denoting that
the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

2.16.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 22.4 MPa; and that are 2 millimeter thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C. Provide 1.3 mm (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties must have a minimum loop tensile strength of 778.75 N. The cable tags must have black block letters, numbers, and symbols 25 mm high on a yellow background. Letters, numbers, and symbols must not fall off or change positions regardless of the cable tags' orientation.

2.17 [HIGH][EXTRA-HIGH] VOLTAGE ABOVE GROUND CABLE TERMINATING CABINETS

Cable terminating cabinets must be hook-stick operable, deadfront construction. Provide cabinets with [200 A. loadbreak junctions and elbow-type separable loadbreak connectors, cable parking stands, and grounding lugs][600 A. dead-break junctions and elbow-type separable dead-break connectors, cable parking stands, and grounding lugs]. Provide cable terminating equipment [as indicated].

Ratings at [50][60] Hz must be:

<table>
<thead>
<tr>
<th>Nominal voltage (kV)</th>
<th>[_____]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated maximum voltage (kV)</td>
<td>[[3.3][6.6][15][22][25][33][35][66][77]]</td>
</tr>
<tr>
<td>Rated continuous current (A)</td>
<td>[[200][600]]</td>
</tr>
<tr>
<td>One-second short-time current-carrying capacity (kA)</td>
<td>[_____]</td>
</tr>
<tr>
<td>BIL (kV)</td>
<td>[_____]</td>
</tr>
</tbody>
</table>

2.18 LOW VOLTAGE ABOVE GROUND TERMINATION PEDESTAL

Provide copolymer polypropylene, low voltage above ground termination pedestal manufactured through an injection molding process. Pedestals must resist fertilizers, salt air environments and ultra-violet radiation. Pedestal top must be imprinted with a "WARNING" and "ELECTRIC" identification. Pedestal must contain [three][four] lay-in six port connectors. Connectors must be dual rated for aluminum or copper, and capable of terminating conductors ranging from [5.5 sqmm to 250 sqmm]. Protect each connector with a clear, hard lexan (plastic) cover. Pedestal must be provided with rust-free material and stainless steel hardware. Pedestal must be lockable.

2.19 PROTECTIVE DEVICES AND COORDINATION

Provide protective devices and coordination as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.
2.20 SOURCE QUALITY CONTROL

2.20.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer must test one sample assembly consisting of a straight lead tube 305 mm long with a 65.5 mm outside diameter, and a 3.175 mm thick wall, and covered with one-half lap layer of arc and fireproofing tape per manufacturer's instructions. The arc and fireproofing tape must withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode must be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. The arc must be directed toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Each sample assembly must be tested at three unrelated points. Start time for tests must be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time must be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape must indicate that the test has been performed and passed by the manufacturer.

2.20.2 [HIGH][EXTRA-HIGH] Voltage Cable Qualification and Production Tests

Results of qualification and production tests as applicable for each type of [high][extra-high] voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of applicable codes and standards and IEEE C2. In addition to these requirements, install telecommunications in accordance with MLIT ESS.

3.2 CABLE INSPECTION

Inspect each cable reel for correct storage positions, signs of physical damage, and broken end seals prior to installation. If end seal is broken, remove moisture from cable prior to installation in accordance with the cable manufacturer's recommendations.

[3.3 CABLE INSTALLATION PLAN AND PROCEDURE]

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. [Prepare a checklist of significant requirements][Perform pulling calculations and prepare a pulling plan] and submit along with the manufacturer's instructions in accordance with SUBMITTALS. Install cable strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.
[Calculations and pulling plan must include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall bearing pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 1525 mm outside the building and projections thereof, except that conductors must be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide [PVC, Type EPC-40][IMC][RGS][Type G][Type FEP][Type VP][Type VE][Type HIVP][Type HIVE] conduit from the supply equipment to a point 1525 mm outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors must have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound must conform to manufacturer's recommendations. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures must fit the frames without undue play. Steel and iron must be formed to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete.
Manhole locations, as indicated, are approximate. Coordinate exact manhole locations with other utilities and finished grading and paving.

3.5.1 Cast-In-Place Concrete Structures

[Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.][Provide concrete block conforming to Section 04 20 00 MASONRY.][Concrete block is not allowed in areas subject to aircraft loading.]

3.5.2 Precast Concrete Construction

Set commercial precast structures on 150 mm of level, 90 percent compacted granular fill, 19 mm to 25 mm size, extending 305 mm beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation must additionally conform to the manufacturer's instructions.

3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices must be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor the irons must be a minimum of 150 mm from the edge of the sump, and in the walls the irons must be located within 150 mm of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron must not be located within 150 mm of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 150 mm clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 915 mm length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner must be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 75 mm from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons must have a clear projection into the structure of approximately 100 mm and must be designed to withstand a minimum pulling-in load of 26,700 N. Irons must be hot-dipped galvanized after fabrication.

3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators must be sufficient to accommodate the cables. Space racks in power manholes not more than 915 mm apart, and provide each manhole wall with a minimum of two racks. Space racks in signal manholes not more than 420 mm apart with the end rack being no further than 305 mm from the adjacent wall. Methods of anchoring cable racks must be as follows:

a. Provide a 15 mm diameter by 125 mm long anchor bolt with 75 mm foot
cast in structure wall with 50 mm protrusion of threaded portion of bolt into structure. Provide 15 mm steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 1192 kg per meter. Insert channel must be steel of the same length as "vertical rack channel;" channel insert must be cast flush in structure wall. Provide 15 mm steel nuts in channel insert to receive 15 mm diameter by 75 mm long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert must have minimum 365 kg load rating. Provide 15 mm diameter by 75 mm long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

3.5.5 Field Painting

Cast-iron frames and covers not buried in concrete or masonry must be cleaned of mortar, rust, grease, dirt and other deleterious materials, and given a coat of bituminous paint.

3.6 DIRECT BURIAL CABLE SYSTEM

Cables must be buried directly in the earth below the frostline [as indicated][to the requirements of IEEE C2 and JIS C 0365, whichever is more stringent].

3.6.1 Trenching

Excavate trenches for direct-burial cables to provide a minimum cable cover of 610 mm below finished grade for power conductors operated at 600 volts or less, and 765 mm below finished grade for over 600 volts in accordance with IEEE C2 and JIS C 0365. When rock is encountered, remove to a depth of at least 75 mm below the cable and fill the space with sand or clean earth free from particles larger than 6 mm. Bottoms of trenches must be smooth and free of stones and sharp objects. Where materials in bottoms of trenches are other than sand, a 75 mm 3 inch layer of sand must be laid first and compacted to approximate densities of surrounding firm soil. Trenches must be not less than [150][200] mm wide, and must be in straight lines between cable markers.[ Cable plows must not be used.] Bends in trenches must have a radius [of not less than 915 mm][consistent with the cable manufacturer's published minimum cable bending radius for the cable installed].

3.6.2 Cable Installation

Unreel cables along the sides of or in trenches and carefully place on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position is not permitted, except as required to pull cables through conduits under paving or railroad tracks. Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 75 mm apart, except that communication cable must be separated from power cable by a minimum distance of 305 mm. Where direct-burial cables cross under roads or other paving exceeding 1.5 m in width, such cables must be installed in[ concrete-encased] ducts.
Where direct-burial cables cross under railroad tracks, such cables must be installed in [reinforced concrete-encased ducts][ducts installed through rigid galvanized steel sleeves]. Ducts must extend at least 1.5 m beyond each edge of any paving and at least 1.5 m beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, direct-burial cables must be centered in duct entrances, and a waterproof nonhardening mastic compound must be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Prevent damage to conduit coatings by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, the paving and subbase must be restored to their original condition. Where cable is placed in duct (e.g. under paved areas, roads, or railroads), slope ducts to drain.

3.6.3 Splicing

Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured.[ Where splices are required, provide splices designed and rated for direct burial.][ Where splices are required, install splices only in maintenance manholes/handholes or cabinets/pedestals.]

3.6.4 Bends

Bends in cables must have an inner radius not less than those specified for the type of cable, per manufacturer's recommendation.

3.6.5 Horizontal Slack

Leave approximately 915 mm of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.[ Enclose splices in lead-sheathed or armored cables in split-type cast-iron splice boxes; after completion of the connection, fill with insulating filler compound and tightly clamp the box.]

3.6.6 Identification Slabs[ or Markers]

Provide a slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways[, over the ends of ducts or conduits stubbed out for future use][, and over each splice]. Identification slabs must be of concrete, approximately 500 mm square by 150 mm thick and must be set flat in the ground so that top surface projects not less than 20 mm, nor more than 30 mm above ground. Concrete must have a compressive strength of not less than 20 MPa and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "telephone cable," "splice," or other applicable designation on the top surface of the slab before concrete hardens. Inscribe circuit identification symbols on slabs as indicated. Letters or figures must be approximately 50 mm high and grooves must be approximately 6 mm in width and depth. Install slabs so that the side nearest the inscription on top must include an arrow indicating the side nearest the cable. Provide color, type and depth of warning tape as specified in Section [31 23 00.00 20 EXCAVATION AND FILL][31 00 00 EARTHWORK].
3.7 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.7.1 Requirements

Run conduit in straight lines except where a change of direction is necessary. Provide numbers and sizes of ducts as indicated. Provide a 100 sqmm bare copper grounding conductor for [high][extra-high]-voltage distribution duct banks as indicated in drawings. Bond grounding conductor to ground rings (loops) in all manholes and to ground rings (loops) at all equipment slabs (pads). Route grounding conductor into manholes with the duct bank (sleeving is not required). Ducts must have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of [75 mm][100 mm] per 30 m. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Provide ducts with end bells whenever duct lines terminate in structures.

Perform changes in ductbank direction as follows:

a. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable.

b. The minimum manufactured bend radius must be 450 mm for ducts of less than 80 mm diameter, and 900 mm for ducts 80 mm or greater in diameter.

c. As an exception to the bend radius required above, provide field manufactured longsweep bends having a minimum radius of 7.6 m for a change of direction of more than 5 degrees, either horizontally or vertically, using a combination of curved and straight sections. Maximum manufactured curved sections: 30 degrees.

3.7.2 Treatment

Ducts must be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers must be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer must be used whenever an existing duct is connected to a duct of different material or shape. Ducts must be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts must be thoroughly cleaned before being laid. Plastic ducts must be stored on a flat surface and protected from the direct rays of the sun.

3.7.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 75 mm and larger, draw a flexible testing mandrel approximately 305 mm long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 75 mm, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.7.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, must be zinc-coated, rigid steel, jacked into place. Where ducts are jacked under existing pavement,
rigid steel conduit must be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks must be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.2 m on centers. [Hydraulic jet method must not be used.]

[3.7.5] Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations must be PVC coated and must extend from at least 50 mm within the concrete to the first coupling or fitting outside the concrete (minimum of 150 mm from penetration).

]3.7.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 75 mm[, except that light and power conduits must be separated from control, signal, and telephone conduits by a minimum distance of [300] mm]. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly must consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 3050 mm of conduit assembly.

3.7.7 Conduit Plugs and Pull Rope

New conduit indicated as being unused or empty must be provided with plugs on each end. Plugs must contain a weep hole or screen to allow water drainage. Provide a plastic pull rope having 915 mm of slack at each end of unused or empty conduits.

3.7.8 Conduit and Duct Without Concrete Encasement

Depths to top of the conduit must be not less than 610 mm below finished grade. Provide not less than 75 mm clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 75 mm, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 6.25 mm sieve. The first 150 mm layer of backfill cover must be sand compacted as previously specified. The rest of the excavation must be backfilled and compacted in 75 to 150 mm layers. Provide color, type and depth of warning tape as specified in Section [31 23 00.00 20 EXCAVATION AND FILL][31 00 00 EARTHWORK].

3.7.8.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 75 mm concrete cover around ducts. Concrete encasement must extend at least 1525 mm beyond the edges of paved areas and roads, and 3660 mm beyond the rails on each side of railroad tracks. Depths to top of the concrete envelope must be not less than 610 mm below finished grade[, and under railroad tracks not less than 1270 mm below the top of the rails].

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3.7.8.2 Directional Boring

HDPE conduits must be installed below the frostline and as specified herein.

[For distribution voltages greater than 1000 volts and less than 34,500 volts, depths to the top of the conduit must not be less than 1220 mm in pavement-covered areas and not less than 3050 mm in non-pavement-covered areas.][For distribution voltages less than 1000 volts, depths to the top of the conduit must not be less than 1220 mm in pavement- or non-pavement-covered areas.][For branch circuit wiring less than 600 volts, depths to the top of the conduit must not be less than 610 mm in pavement- or non-pavement-covered areas.]

3.7.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Depths to top of the concrete envelope must be not less than 450 mm below finished grade[, except under roads and pavement, concrete envelope must be not less than 610 mm below finished grade][, and under railroad tracks not less than 1270 mm below the top of the rails]. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank must be rectangular in cross-section and must provide at least 75 mm of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 75 mm. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring must be done by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly.[Provide steel reinforcing in the concrete envelope as indicated.][Provide color, type and depth of warning tape as specified in Section [31 00 00 EARTHWORK][31 23 00.00 20 EXCAVATION AND FILL.]]

3.7.9.1 Connections to Manholes

Duct bank envelopes connecting to underground structures must be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section must be larger than the corresponding manhole opening dimensions by no less than 300 mm in each direction. Perimeter of the duct bank opening in the underground structure must be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.7.9.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and [extend into][bend out to tie into the reinforcing of] the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7.9.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and [extend into][bend out to tie into the reinforcing of] the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.
3.7.9.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks. Remove existing cables which constitute interference with the work. Abandon in place those no longer used ducts and cables which do not interfere with the work.

3.7.9.5 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 610 mm back into the envelope and a minimum of 610 mm beyond the end of the envelope. Provide one No. 13 bar in each corner, 75 mm from the edge of the envelope. Secure corner bars with two No. 10 ties, spaced approximately 305 mm apart. Restrain reinforcing assembly from moving during concrete pouring.

3.7.9.6 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

3.7.10 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.8 CABLE PULLING

[Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. ]Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with[ tape][ or][ wire] shield must have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.8.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.9 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare
cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

3.9.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

3.10 CONDUCTORS INSTALLED IN PARALLEL

Conductors must be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.11 LOW VOLTAGE CABLE SPlicing AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set.[ Make splices in underground distribution systems only in accessible locations such as manholes, handholes, or aboveground termination pedestals.]

[3.11.1 Terminating Aluminum Conductors

a. Use particular care in making up joints and terminations. Remove surface oxides by cleaning with a wire brush or emery cloth. Apply joint compound to conductors, and use UL-listed solid aluminum connectors for connecting aluminum conductors. When connecting aluminum to copper conductors, use connectors specifically designed for this purpose.

b. Terminate aluminum conductors to copper bus either by: (1) in line splicing a copper pigtail to the aluminum conductor (copper pigtail must have an ampacity at least that of the aluminum conductor); or (2) using a circumferential compression type, aluminum bodied terminal lug UL listed for AL/CU and steel Belleville spring washers, flat washers, bolts, and nuts. Belleville spring washers must be cadmium-plated hardened steel. Install the Belleville spring washers with the crown up toward the nut or bolt head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville. Tighten nuts sufficient to flatten Belleville and leave in that position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

c. Terminate aluminum conductors to aluminum bus by using all-aluminum nuts, bolts, washers, and lugs. Wire brush and apply inhibiting compound to conductor prior to inserting in lug. Lubricate hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).
3.12  [HIGH][EXTRA-HIGH] VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

3.13  [HIGH][EXTRA-HIGH] VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

3.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods must be as specified elsewhere in this section. Wire must be trained to the sides of the enclosure to prevent interference with the working area.

3.13.2 Joints in Armored Cables

Armored cable joints must be enclosed in compound-filled, cast-iron or alloy splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.14  CABLE END CAPS

Cable ends must be sealed at all times with coated heat shrinkable end caps. Cables ends must be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps must remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.15  LIVE END CAPS

Provide live end caps for single conductor [high][extra-high] voltage cables where indicated.

3.16  FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.16.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

3.16.2 Tape-Wrap

Tape-wrap metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to
application of fireproofing. Wrap must be in the form of two tightly applied half-lapped layers of a pressure-sensitive 0.254 mm thick plastic tape, and must extend not less than 25 mm into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

3.17 GROUNDING SYSTEMS

IEEE C2 and JIS C 0365, except provide grounding systems with a resistance to solid earth ground not exceeding [25][_____] ohms.

3.17.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus [150 mm] [300 mm], installed to provide an earth ground of the appropriate value for the particular equipment being grounded. If the specified ground resistance is not met, an additional ground rod must be provided (placed not less than 1830 mm from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.17.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies must be as recommended by the manufacturer. An embossing die code or other standard method must provide visible indication that a connector has been adequately compressed on the ground wire.

3.17.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with 14 sqmm. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of 14 sqmm. Provide direct connections to the grounding conductor with 600 v insulated, full-size conductor for each grounded neutral of each feeder circuit, which is spliced within the manhole.

3.17.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.
3.17.5 Manhole Grounding

Loop a 100 sqmm grounding conductor around the interior perimeter, approximately 305 mm above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 914 mm. Connect the conductor to the manhole grounding electrode with 100 sqmm conductor. Connect all incoming 100 sqmm grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 14 sqmm conductor.

3.17.6 Fence Grounding

[Provide grounding for fences as indicated.][Provide grounding for fences with a ground rod at each fixed gate post and at each corner post.] Drive ground rods until the top is 305 mm below grade. Attach a 22 sqmm copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 305 mm of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Each gate section must be bonded to its gatepost by a 3 by 25 mm flexible braided copper strap and ground post clamps. Clamps must be of the anti-electrolysis type.

3.17.7 Metal Splice Case Grounding

Metal splice cases for [high][extra-high]-voltage direct-burial cable must be grounded by connection to a driven ground rod located within 600 mm of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than 14 sqmm.

3.18 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with Section [31 23 00.00 20 EXCAVATION AND FILL][31 00 00 EARTHWORK].

3.18.1 Reconditioning of Surfaces

3.18.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct [or direct burial cable]. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.[ Provide work in accordance with Section 32 92 19 SEEDING and Section 32 93 00 EXTERIOR PLANTS.]

3.18.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists [, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.][ Make repairs as specified in Section 32 13 13.06 PORTLAND CEMENT CONCRETE
3.19 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.19.1 Concrete Slabs (Pads) for Equipment

Unless otherwise indicated, the slab must be at least 200 mm thick, reinforced with a 150 mm by 150 mm - MW19 by MW19 (6 by 6 - W2.9 by W2.9) mesh, placed uniformly 100 mm from the top of the slab. Slab must be placed on a 150 mm thick, well-compacted gravel base. Top of concrete slab must be approximately 100 mm above finished grade with gradual slope for drainage. Edges above grade must have 15 mm chamfer. Slab must be of adequate size to project at least 200 mm beyond the equipment.

Stub up conduits, with bushings, 50 mm into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

3.19.2 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals must be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.20 FIELD QUALITY CONTROL

3.20.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with Denki Hoan Kyoukai and MLIT DSKKS.

3.20.1.1 [High][Extra-High] Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

   (1) Inspect exposed cable sections for physical damage.

   (2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

   (3) Inspect for proper shield grounding, cable support, and cable termination.

   (4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

   (5) Inspect for proper fireproofing.

   (6) Visually inspect jacket and insulation condition.

   (7) Inspect for proper phase identification and arrangement.
b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests must be very low frequency (VLF) alternating voltage withstand tests. VLF test frequency must be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages must be as follows:

<table>
<thead>
<tr>
<th>CABLE RATING</th>
<th>AC TEST VOLTAGE for Acceptance Testing</th>
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</thead>
<tbody>
<tr>
<td>3.3kV</td>
<td>9kV (peak)</td>
</tr>
<tr>
<td>5 kV</td>
<td>10kV rms (peak)</td>
</tr>
<tr>
<td>6.6 kV</td>
<td>17kV rms (peak)</td>
</tr>
<tr>
<td>8 kV</td>
<td>13kV rms (peak)</td>
</tr>
<tr>
<td>15 kV</td>
<td>20kV rms (peak)</td>
</tr>
<tr>
<td>22 kV</td>
<td>44kV rms (peak)</td>
</tr>
<tr>
<td>25 kV</td>
<td>31kV rms (peak)</td>
</tr>
<tr>
<td>33 kV</td>
<td>63kV (peak)</td>
</tr>
<tr>
<td>35 kV</td>
<td>44kV rms (peak)</td>
</tr>
<tr>
<td>66 kV</td>
<td>85kV (peak)</td>
</tr>
<tr>
<td>77 kV</td>
<td>95kV (peak)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CABLE RATING</th>
<th>AC TEST VOLTAGE for Maintenance Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3kV</td>
<td>Per manufacturer requirements.</td>
</tr>
<tr>
<td>5 kV</td>
<td>7kV rms (peak)</td>
</tr>
<tr>
<td>6.6 kV</td>
<td>Per manufacturer requirements.</td>
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<tr>
<td>8 kV</td>
<td>10kV rms (peak)</td>
</tr>
<tr>
<td>CABLE RATING AC TEST VOLTAGE for MAINTENANCE TESTING</td>
<td></td>
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<tr>
<td>-----------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>15 kV</td>
<td>16kV rms(peak)</td>
</tr>
<tr>
<td>22 kV</td>
<td>Per manufacturer requirements.</td>
</tr>
<tr>
<td>25 kV</td>
<td>23kV rms(peak)</td>
</tr>
<tr>
<td>33 kV</td>
<td>Per manufacturer requirements.</td>
</tr>
<tr>
<td>35 kV</td>
<td>33kV rms(peak)</td>
</tr>
<tr>
<td>66 kV</td>
<td>Per manufacturer requirements.</td>
</tr>
<tr>
<td>77 kV</td>
<td>Per manufacturer requirements.</td>
</tr>
</tbody>
</table>

(3) In lieu of the acceptance testing required in item (2), High Voltage Direct Current (HVDC) test is an alternative acceptance test on newly installed cables. Maximum applied DC test voltage shall be determined in consultation with the manufacturer of the cable and cable accessories for the type of cable being tested. The maximum test voltage to be maintained for 10 minutes. After reaching the maximum test voltage, the current magnitude should be recorded at least twice: once at approximately 2 min and again at the end of the test period (10 min) Contractor shall submit test procedure and standard use as reference for testing to the government for review and approval.

3.20.1.2 Low Voltage Cables, 600-Volt

Perform tests after installation of cable, splices and terminations and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Verify tightness of accessible bolted electrical connections.

(4) Inspect compression-applied connectors for correct cable match and indentation.

(5) Visually inspect jacket and insulation condition.

(6) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform insulation resistance tests on wiring 14 sqmm and larger diameter using instrument which applies voltage of approximately
(2) Perform continuity tests to insure correct cable connection.

3.20.1.3 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with JIS C 60364-6. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument must be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.20.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer must be given 5 working days advance notice of the dates and times of checking and testing.

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Contractor may substitute compatible Japan Industrial Standard (JIS) or Japan Wire Industry Association Standard (JCS) standards for non-Japanese standards, as approved by the Contracting Officer's representative.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2   (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

JAPANESE INDUSTRIAL STANDARDS (JIS)

JIS C 2336   (2012) Pressure-sensitive polyvinyl chloride tapes for electrical purposes
JIS C 2338   (2012) Polyester adhesive tape for electrical insulation
JIS C 3101   (1994) Hard-drawn copper wires for electrical purposes
JIS C 3105   (1994) Hard-drawn copper stranded conductors
JIS C 3307   (2000) 600 V Polyvinyl chloride insulated wires
JIS C 3401   (2002) Control Cables
JIS C 6188   (1999) Test methods of measuring optical attenuators
JIS C 6189   (2004) Test methods of optical return loss meters
JIS C 6824   (2009) Test methods for bandwidth of multimode optical fibers
JIS C 6835   (2017) Silica glass single-mode optical
fibers

JIS C 6837 (2015) All Plastic Multimode Optical Fibers


JIS C 6870-3-10 (2011) Optical fiber cables-Part 3-10: Outdoor cables-Family specification for duct, directly buried and lashed aerial optical telecommunications cables


JIS X 5150 (R2016) Information Technology-Generic Cabling for Customer Premises


JAPAN WIRE INDUSTRY ASSOCIATION STANDARD (JCS)

JCS 5503 (2011) Flame retardant polyolefin sheath LAN twisted pair cable

JCS 5507 (2010) LAN Twisted Pair Cable

1.2 RELATED REQUIREMENTS

[ Section 27 10 00, BUILDING TELECOMMUNICATIONS CABLEING SYSTEM, ][Section 33 71 01, OVERHEAD TRANSMISSION AND DISTRIBUTION, and][Section 33 71 02, UNDERGROUND ELECTRICAL DISTRIBUTION] apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in JIS X 5150, JCS 5507, JIS C 6850 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.
1.3.3 Entrance Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect – (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use. [The telecommunications contractor must coordinate with the NMCI contractor concerning layout and configuration of the EF telecommunications and OSP. The telecommunications contractor may be required to coordinate work effort for access to the EF telecommunications and OSP with the NMCI contractor.]

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for information only.][for Contractor Quality Control approval.] When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications Outside Plant; G[], [_____]

Telecommunications Entrance Facility Drawings; G[], [_____]

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G[], [_____]

Cable splices, and connectors; G[], [_____]
Closures; G[, [_____]]

Building protector assemblies; G[, [_____]]

Protector modules; G[, [_____]]

Cross-connect terminal cabinets; G[, [_____]]

SD-06 Test Reports

Pre-installation tests;

Acceptance tests;

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5;

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than[ 2][_____] months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation;

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with JIS C 6870-3 and JIS C 6870-3-10 for aerial system design, and for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings. Drawings shall include wiring and schematic diagrams for
fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. [Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant.][Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation.] The telecommunications outside plant (OSP) shop drawings shall be included in the operation and maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

[Provide T3 drawings for EF Telecommunications that include telecommunications entrance facility plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and[ cabinet][, rack][, backboard][ and] wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.][Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLEING SYSTEMS.] The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the[ copper conductor][ and][ optical fiber] cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers without interrupting service to any active location. Submit the plan at least[ 30] days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with JIS X 5150 and JIS X 5151. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal
material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of applicable codes and standards unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 152 meter length with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature.
variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Provide T5 drawings including documentation on cables and termination hardware. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided in hard copy format on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation, shall be provided. Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation. Provide the following T5 drawing documentation as a minimum:

a. Cables - A record of installed cable shall be provided. The cable records shall include only the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility. Include manufacture date of cable with submittal.

b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type. Documentation shall include only the required data fields as a minimum.

Provide record documentation as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABBING SYSTEM.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained 5 pin screw type unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for [_____] pairs of outside cable. Building
protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLELING SYSTEM.

2.2.2 Protector Modules

Provide [three][two]-electrode gas tube or solid state type[5 pin][screw type] rated for the application. Provide gas tube protection modules [heavy duty, A>10kA, B>400, C>65A][maximum duty, A>20kA, B>1000, C>200A] where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide fiber optic cable terminations as specified in 27 10 00 BUILDING TELECOMMUNICATIONS CABLELING SYSTEM.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Aerial Cable Closures

Provide cable closure assembly consisting of a frame with clamps, a lift-off polyethylene cover, cable nozzles, and drop wire rings. Closure shall be suitable for use on Figure 8 cables. Closures shall be free breathing and suitable for housing[straight-through type][branch type][of the type indicated] splices of non-pressurized communications cables and shall be sized as indicated. The closure shall be constructed with ultraviolet resistant PVC.

2.3.1.2 Underground Cable Closures

a. Aboveground: Provide aboveground closures constructed of[not less than 14 gauge steel][ultraviolet resistant PVC] and acceptable for[pole][stake] mounting. Closures shall be sized and contain a marker as indicated. Covers shall be secured to prevent unauthorized entry.

b. Direct burial: Provide buried closure suitable for enclosing a straight, butt, and branch splice in a container into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity in the buried environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases.

c. In vault or manhole: Provide underground closure suitable to house a straight, butt, and branch splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases.
2.3.2 Fiber Optic Closures

2.3.2.1 Aerial

Provide aerial closure that is free breathing and suitable for housing splice organizer of non-pressurized cables. Closure shall be constructed from heavy PVC with ultraviolet resistance.

2.3.2.2 Direct Burial

Provide buried closure suitable to house splice organizer in protective housing into which can be poured an encapsulating compound. Closure shall have adequate strength to protect the splice and maintain cable shield electrical continuity, when metallic, in buried environment. Encapsulating compound shall be reenterable and shall not alter chemical stability of the closure.

2.3.2.3 In Vault or Manhole

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

2.4 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS

Provide in accordance with the following:

a. Constructed of 14 gauge steel or [______].

b. Equipped with a double set of hinged doors with closed-cell foam weatherstripping. Doors shall be locked and contain a marker as indicated.

c. Equipped with spool spindle bracket, mounting frames, binding post log, [and] jumpering instruction label[, and load coil mounting provisions].

d. Complete with cross connect modules to terminate number of pairs as indicated.

e. Sized as indicated.

2.5 CABLE SPLICES, AND CONNECTORS

2.5.1 Copper Cable Splices

Provide[ multipair,[ foldback][ in-line]][ single pair,[ in-line][ butt][ box tap]] splices of a moisture resistant,[ two][ three][______]-wire [insulation displacement] connector held rigidly in place to assure maximum continuity. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.
2.5.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 0.65 to 0.4 mm solid wire with a maximum insulation diameter of 1.65 mm. Fill connector with sealant grease to make a moisture resistant connection.

2.5.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for mechanical methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with JIS C 6823 using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with JIS C 6189. Physically protect each fiber optic splice by a splice kit specially designed for the splice.

2.5.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 1 m of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.5.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor.

2.6 CONDUIT

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.7 PLASTIC INSULATING TAPE

JIS C 2336 or JIS C 2338.

2.8 WIRE AND CABLE

2.8.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper conductor shall conform to the following:
2.8.1.1 Underground

Provide filled cable meeting the requirements of applicable codes and standards.

2.8.1.2 Aerial

Provide filled cable meeting the requirements of JCS 5503.

2.8.1.3 Screen

Provide screen-compartmental core cable filled cable [ ][as indicated].

2.8.2 Fiber Optic Cable

Provide[ single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with JIS C 6835][ single-mode, 8/125-um, 0.10 aperture 1550 nm fiber optic cable in accordance with JIS C 6835][ and ][ multimode 62.5/125-um, 0.275 aperture fiber optic cable in accordance with JIS C 6837 ][ multimode 50/125-um, 0.275 aperture fiber optic cable JIS C 6837], JIS C 6870-3 and JIS C 6870-3-10 including any special requirements made necessary by a specialized design. Provide[ 12][ ____] optical fibers[ as indicated]. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with JIS C 6870-3-10.

2.8.2.1 Strength Members

Provide[ central][ non-central],[ non-metallic][ metallic] strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with JIS C 6870-3 and JIS C 6870-3-10. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.8.2.2 Shielding or Other Metallic Covering

Provide[ copper, copper alloy or copper and steel laminate][ copper and stainless steel, coated stainless steel or bare low carbon steel][ bare aluminum or coated aluminum],[ single][ dual] tape covering or shield in accordance with JIS C 6870-3 and JIS C 6870-3-10.

2.8.2.3 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with JIS C 6870-3 and JIS C 6870-3-10.

2.8.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with JIS C 60364-5-54, IEEE C2 and JIS C 0365. Solid bare copper wire meeting the requirements of JIS C 3101 for sizes 8 sqmm and smaller and stranded bare copper wire meeting the requirements of JIS C 3105, for sizes 14 sqmm and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of JIS C 3307 and JIS C 3401.

2.9 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with
2.10 POLES AND HARDWARE

Provide poles and hardware as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION.

2.11 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be [stainless steel] [or] [polyethylene] and labeled [as indicated]. Handwritten labeling is unacceptable.

[2.11.1 Stainless Steel]

Provide stainless steel, cable tags 41.25 mm in diameter 1.58 mm thick minimum, and circular in shape. Tags shall be die stamped with numbers, letters, and symbols not less than 6.35 mm high and approximately 0.38 mm deep in normal block style.

[2.11.2 Polyethylene Cable Tags]

Provide tags of polyethylene that have an average tensile strength of 22.4 MPa; and that are two millimeter thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 77 degrees C. Provide 1.3 mm (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ties shall have a minimum loop tensile strength of 778.75 N. The cable tags shall have black block letters, numbers, and symbols 25 mm high on a yellow background. Letters, numbers, and symbols shall not fall off or change positions regardless of the cable tags' orientation.

2.12 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00, EARTHWORK.

2.13 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding. Braid shall be made from flat tin-plated copper.

2.14 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.15 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with JIS K 6911 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine
plastic, 3 mm thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm. Lettering shall be a minimum of 6.35 mm high normal block style.

2.16 TESTS, INSPECTIONS, AND VERIFICATIONS

2.16.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with JIS X 5150 and JIS C 6850. Use JIS C 6823 for single mode fiber and for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP). Enhanced performance air core OSP copper cables shall meet the requirements of JCS 5503. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, JIS C 0365 and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Direct Burial System

Installation shall be in accordance with JIS C 6870-3 and JIS C 6870-3-10. Under railroad tracks, paved areas, and roadways install cable in conduit encased in concrete. Slope ducts to drain. Excavate trenches by hand or mechanical trenching equipment. Provide a minimum cable cover of 610 mm below finished grade. Trenches shall be not less than 155 mm wide and in straight lines between cable markers. Do not use cable plows. Bends in trenches shall have a radius of not less than [915] mm. Where two or more cables are laid parallel in the same trench, space laterally at least 78 mm apart. When rock is encountered, remove it to a depth of at least 78 mm below the cable and fill the space with sand or clean earth free from particles larger than 6 mm. Do not unreel and pull cables into
the trench from one end. Cable may be unreeled on grade and lifted into position. Provide color, type and depth of warning tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00 EARTHWORK.

3.1.3.1 Cable Placement

a. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than [78][_____] mm of well tamped earth. Do not install circuits for communications under or above traffic signal loops.

b. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.

c. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

d. Leave a horizontal slack of approximately 915 mm in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections.

3.1.3.2 Identification Slabs [Markers]

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 508 mm square by 155 mm thick.

3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 53 mm thick on the floor of the trench before placing the cable or wire. The backfill for at least 103 mm above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 610 mm in depth[, a protective cover of[ metal][ concrete] shall be used].

3.1.4 Cable Protection

Provide direct burial cable protection in accordance with applicable codes and standards and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 155 mm per 305 mm burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40 percent of cross-sectional area, or in concrete encased 103 mm PVC pipe. Conduit may be installed by jacking or trenching. Trenches shall be backfilled with earth and mechanically tamped at 155 mm lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.
3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

3.1.5 Underground Duct

Provide underground duct and connections to existing manholes, handholes, concrete pads, and existing ducts as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein.

3.1.6 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.7 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.8 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.8.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.
3.1.8.2 Pulling Eyes

Equip cables 32 mm in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 32 mm with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 19 mm links between pulling-in eyes or grips and pulling strand.

3.1.8.3 Installation of Cables in Manholes, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. [Provide a minimum of 15 meter maintenance loop for all cables at maintenance hole feeding building entrance facilities.] Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 1220 mm. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.9 Aerial Cable Installation

Pole installation shall be as specified in Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION. Where physical obstructions make it necessary to pull distribution wire along the line from a stationary reel, use cable stringing blocks to support wire during placing and tensioning operations. Do not place ladders, cable coils, and other equipment on or against the distribution wire. Wire shall be sagged in accordance with the data shown. Protect cable installed outside of building less than 2.5 meters above finished grade against physical damage.

3.1.9.1 Figure 8 Distribution Wire

Perform spiraling of the wire within 24 hours of the tensioning operation. Perform spiraling operations at alternate poles with the approximate length of the spiral being 4575 mm. Do not remove insulation from support members except at bonding and grounding points and at points where ends of support members are terminated in splicing and dead-end devices. Ground support wire at poles to the pole ground.

3.1.9.2 Suspension Strand

Place suspension strand as indicated. Tension in accordance with the data indicated. When tensioning strand, loosen cable suspension clamps enough to allow free movement of the strand. Place suspension strand on the road side of the pole line. In tangent construction, point the lip of the suspension strand clamp toward the pole. At angles in the line, point the suspension strand clamp lip away from the load. In level construction place the suspension strand clamp in such a manner that it will hold the strand below the through-bolt. At points where there is an up-pull on the strand, place clamp so that it will support strand above the through-bolt. Make suspension strand electrically continuous throughout its entire length, bond to other bare cables suspension strands and connect to pole ground at each pole.
3.1.9.3 Aerial Cable

Keep cable ends sealed at all times using cable end caps. Take cable from reel only as it is placed. During placing operations, do not bend cables in a radius less than 10 times the outside diameter of cable. Place temporary supports sufficiently close together and properly tension the cable where necessary to prevent excessive bending. In those instances where spiraling of cabling is involved, accomplish mounting of enclosures for purposes of loading, splicing, and distribution after the spiraling operation has been completed.

3.1.10 Cable Splicing

3.1.10.1 Copper Conductor Splices

Perform splicing in accordance with manufacturer's requirements except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.10.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss [not greater than 0.2 dB for fusion splices] [not greater than 0.4 dB for mechanical splices].

3.1.11 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end.

3.1.12 Grounding

Provide grounding and bonding in accordance with JIS C 60364-5-54 and IEEE C2 and JIS C 0365. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.12.1 Telecommunications Master Ground Bar (TMGB)

The TMGB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a TMGB for connection point for cable stub shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.12.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.12.3 Campus Distributor Grounding

a. Protection assemblies: Mount CD protector assemblies directly [on the telecommunications backboard] [in the telecommunications [rack] [cabinet]]. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to TMGB.
[ b. TMGB connection: Connect TMGB to TGB with copper conductor with a total resistance of less than 0.01 ohms.

][3.1.13 Cut-Over

All necessary transfers and cut-overs shall be accomplished by the telecommunications contractor.

]3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware shall be provided using[ thermal ink transfer process][ laser printer][______].

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice.[ Tag only new wire and cable provided by this contract.][ Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract.] The labeling of telecommunications cable tag identifiers shall be[ as indicated][ Tag legend shall be as indicated.] Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers.

3.3 FIELD APPLIED PAINTING

[Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations.][Provide ferrous metallic enclosure finishes as specified in Section 09 90 00 PAINTS AND COATINGS.]

[3.3.1 Cleaning

Clean surfaces as required per applicable codes and standards.

][3.3.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 0.127 mm. Apply in two coats to a total dry film thickness of 0.127 to 0.2 mm.

][3.3.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50
percent solids by volume. Apply to a minimum dry film thickness of 0.05 to 0.076 mm. Color shall be the manufacturer's standard.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with JIS X 5150 and JIS X 5151 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the
capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with JIS C 6870-3 and JIS C 6870-3-10:

a. Wire map (pin to pin continuity)
b. Continuity to remote end
c. Crossed pairs
d. Reversed pairs
e. Split pairs
f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

Test fiber optic cable and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, \( 20 \)\( m \) minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with JIS C 6823 for single-mode fiber and for multimode fiber. Splice losses shall not exceed 0.3 db.

b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a\( 850\)[ 1300][ 1310][ 1550] nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with\( JIS C 6188 \) for multimode\( JIS C 6823 \) for single-mode fiber optic cables. The measurement method shall be in accordance with JIS C 6823. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber. Attenuation losses shall not exceed 5.0 db/km at 850 nm and 1.5 db/km at 1300 nm for multimode fiber.

c. Bandwidth Test: The end-to-end bandwidth of all multimode fiber span links shall be measured by the frequency domain method. The bandwidth
shall be measured in both directions on all fibers. The bandwidth measurements shall be in accordance with JIS C 6824.

3.5.3 Soil Density Tests

[a. Determine soil-density relationships for compaction of backfill material.

[b. Determine soil-density relationships as specified for soil tests in Section 31 00 00 EARTHWORK.

] -- End of Section --