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SPECIFICATION OF MATERIALS

NEW REDEMPTION HOSPITAL
Monrovia, Liberia

CONSTRUCTION DOCUMENTS

Client:
Ministry of Health, Republic of Liberia

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Access to site.
5. Work restrictions.

1.3 PROJECT INFORMATION

A. Project Identification: Redemption Hospital.

1. Project Location: Caldwell Township, Montserrado County, Republic of Liberia.

B. Owner: Ministry of Health, Republic of Liberia.

C. Architect: MASS Design Studio, LLC.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. New 9,100 square meters, two story 155-bed tertiary care hospital. Work consists of site grading, excavation, underground utilities, concrete, steel, interior finishes, Mechanical, Electrical and Plumbing Work.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

C. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

D. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form directed by Architect.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or revisions needed to other parts of the Work and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project.

j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: According to Architect’s determination the form of acceptance will be Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications. Coordinate final documents and procedures with Architect along with instructions found in the Owner Contractor Agreement.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or minimum of 20 business days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
    e. Quotation Form: Use forms acceptable to Architect and Owner.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system not indicated.
7. Proposal Request Form: Use form acceptable to Architect and Owner.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on form provided by Architect. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

MINISTRY OF HEALTH
Republic of Liberia

MASS.

CHANGE ORDER

OWNER	☐	FIELD	
ARCHITECT	☐	OTHER	■
CONTRACTOR	☐		☐

PROJECT:
Redemption Hospital
TO CONTRACTOR:

CHANGE ORDER #: 001
DATE: XX-XX-XX
PROJECT #: 1517

The design is changed as follows:

APPROVED REJECTED _____ _____

Not valid until signed by the Owner, Architect, Engineer, and Contractor.

The original Guaranteed maximum Price) was	
Net change by previously authorized Change orders	
The Guaranteed maximum Price prior to this Change order was	
The Guaranteed maximum price will be unchanged by this Change Order in the amount of*	
The new Guaranteed maximum Price including this Change order will be	
The original Contingency was	
The Contingency prior to this Change order was	
The remaining Contingency after this Change order is	

The Contract Time will be unchanged by this Change order.*
The date of Substantial Completion as of the date of this Change Order therefore is July 15, 2013.

*All cost and schedule implications submitted by contractor.
NOTE: This summary does not reflect changes in the Contract Sum, Contract Time or Guaranteed Maximum Price which have been authorized without notification of architect or owner's representative.

MASS Design Group		
ARCHITECT	CONTRACTOR	ENGINEER
334 Boylston Street, Suite 400 Boston, MA 02116		
Address	Address	Address
BY	BY	BY
DATE	DATE	DATE

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Applications for Payment.

1.2 APPLICATIONS FOR PAYMENT

A. Payment Certificate Schedule: Refer to the Agreement between Owner and Contractor for payment submission schedule.

B. Payment Certificate Forms: Use Architect accepted form as form for Payment Certificate.

1. Form Content: Use Project Manual table of contents as a guide to establish line items. Provide at least one line item for each Specification Section.

a. Form Information: Refer to the Agreement between Owner and Contractor for final requirements. For each payment request the following information shall be included but not limited to:

1) Date of submittal.
2) Project name and location.
3) Name of Architect.
4) Architect's project number.
5) Contractor's name and address.
6) Related Specification Section or Division.
7) Description of the Work.
8) Name of subcontractor.
9) Name of manufacturer or fabricator.
10) Name of supplier.
11) Estimated contract value of the Works executed and the Contractor’s Documents produced up to the end of the month.
12) Change Orders (numbers) that affect value.
13) Any amounts to be added and deducted for changes in legislation and changes in cost and percentage of retention.
14) Any amounts to be added for the advance payment.
15) Any amounts to be added and deducted for Plant and Materials
16) Any amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.

C. Transmittal: Refer to the Agreement between Owner and Contractor for documentation requirements.

D. Final Payment Certification: After completing Project closeout requirements, submit final Payment Certificate with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. Evidence that claims have been settled.
5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
6. Final liquidated damages settlement statement.
7. Taking-Over Certificate documentation.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Requests for Information (RFIs).
3. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Architect shall approve. Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Contractor shall insure coordination. Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI.

1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Form: Provide software-generated form and any attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's Action: Architect and Owner will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Tentative construction schedule.
b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Lines of communications.
f. Procedures for processing field decisions and Change Orders.
g. Procedures for RFIs.

h. Procedures for testing and inspecting.
i. Procedures for processing Applications for Payment.
j. Distribution of the Contract Documents.
k. Submittal procedures.
l. Preparation of record documents.
m. Use of the premises and existing building.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. Coordination of Owner furnished items.
y. First aid.
z. Security.
aa. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Commissioning Agent milestones.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.

w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.
l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Owner-furnished equipment.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions

are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

G. Material Location Reports: Submit at weekly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Special Reports: Submit at time of unusual event.

J. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work under More Than One Contract: Include a separate activity for each contract.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Uninterruptible services.
    c. Use of premises restrictions.
    d. Provisions for future construction.
    e. Seasonal variations.
    f. Environmental control.

6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.

i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.

7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for commencement of the Work. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

A. Daily Construction Reports: Use form provided by Architect. Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTALS

A. Submittal Schedule: At Notice to Proceed, submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Format: Arrange the following information in a tabular format:

a. Add information, such as scheduled dates for purchasing and installation and the activity or event number, if using a CPM construction schedule.
b. Scheduled date for first submittal.
c. Specification Section number and title.
d. Submittal category: Action; informational.
e. Name of subcontractor.
f. Description of the Work covered.
g. Scheduled date for Architect final release or approval.
h. Scheduled date of fabrication.

i. Retain three subparagraphs below if CPM construction schedules are required.
j. Scheduled dates for purchasing.
k. Scheduled dates for installation.
l. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect Digital Data Files: Certain electronic digital data files of the Contract Drawings will be provided upon request to the Architect for Contractor's use in preparing submittals. Contractor must sign the waiver form included with this section and pay the fee associated with the CAD files.

1. Architect will furnish Contractor floor plan digital data drawing file(s) of the Contract Drawings for use in preparing Shop Drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing file(s) as they relate to the Contract Drawings.
b. Digital Drawing Software Program: The Contract Drawings can be made available in AutoCAD version.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow seven (7) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
2. Resubmittal Review: Allow seven (7) days for review of each resubmittal.
3. Sequential Review: Where sequential review of submittals by Architect, Owner, or other parties occur, allow fourteen (14) days for initial review of each submittal.
4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect consultants, allow fifteen (15) days for review of each submittal.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01. A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use form approved by Architect.

E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect action stamp.

G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators and installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Two (2) ways of providing submittals are indicated below.

1. Submit electronic submittals via email as PDF electronic files.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file. Do not submit samples nor sample color selections via email.

2. Submittals: Where electronic files are too large to transmit provide paper submittal, three (3) paper copies of each submittal unless otherwise indicated. Architect will return two copies.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 24 by 36 inches but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file unless noted otherwise.

4. Contractor shall keep an on-going log of all submittals. See form attached that is part of this section.

C. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

    a. PDF electronic file.

D. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

E. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

F. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

G. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

H. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on

evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

I. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

J. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

K. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

L. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

M. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 ARCHITECT ACTION

A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

1. Approved: No further action on submittal is required.
2. Approved as Noted: Incorporate corrections noted in Work and indicate in record drawings. If notes cannot be incorporated into Work, resubmit the submittal with explanation of why notes cannot be complied with and indicate proposed response to address intent of notes.
3. Revise and Resubmit: Incorporate corrections noted in Work and resubmit revised submittal for review.
4. Rejected: Submittal does not meet intent of Contract Documents. Correct deficiencies noted and resubmit for review.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Quality assurance requirements.
2. Quality control requirements.

B. Contractor shall pay and be responsible for all testing and inspections. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner or authorities having jurisdiction are not limited by provisions of this Section.
3. Specific test and inspection requirements are not specified in this Section.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Field Service Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Permits, Licenses, and Certificates: Contractors responsibility. For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven business days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven business days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise specified to remain as part of complete Work.

1.7 QUALITY CONTROL

A. Contractor Responsibilities: Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Contractor to engage a qualified testing agency to perform these quality-control services.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: When specified in other sections, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

C. Retesting/Reinspecting: Provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify

agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible

as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. "Approved": When used to convey Architect's action on Contractor's submittals, applications and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

B. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

C. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

D. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

E. "Provide": Furnish and install, complete and ready for the intended use.

F. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

G. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents except where a specific date is specified or is established by code.

C. Copies of Standards: When copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. When specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.

E. Neither the contractual relationships, duties, nor responsibilities of the parties in Contract nor those of the Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Temporary utilities.
2. Support facilities.
3. Security and protection facilities.
4. Moisture and mold control.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise specified in this Section. Allow other entities to use temporary services and facilities without cost, including, but not limited to Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Temporary Services from Utility Companies:

1. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
2. Water Service: Pay water-service use charges for water used by all entities for construction operations.
3. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

A. Project Signs: Submit Shop Drawing showing temporary project signage, to include project identification signs and directional signs for construction personnel and visitors.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the International Building Code Accessibility Guidelines.

1. Maintain accessible egress from occupied facilities at all times.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service**.**

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
2. Connect temporary sewers to existing systems as directed by Owner.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 9 m of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations.

1. Extend and relocate as Work progress requires, provide detours as necessary for unimpeded traffic flow.
2. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
3. Provide means of removing mud from vehicle wheels before entering streets.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking:

1. Maintain parking areas in a sound condition free of excavated material, construction equipment and products.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs:

1. Identification Signs: Provide Project identification signs.

a. Submit layout of sign board to Architect for approval.

2. Temporary Signs: Provide other signs as required to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

a. Provide temporary, directional signs for construction personnel and visitors.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

H. Temporary Elevator Use: Use of elevators is not permitted.

I. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. General: The following shall be provided where applicable during the construction period.

1. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
2. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
3. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
4. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
5. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
6. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
7. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance,

vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

8. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
9. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
10. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

    a. Prohibit smoking in construction areas.
    b. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
    c. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
    d. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by the average of the smallest and largest diameters at 152 mm above the ground for trees up to, and including, 101 mm size; and 304 mm above the ground for trees larger than 101 mm size.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius equal to the diameter of the drip line.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:

1. Organic Mulch: 0.5-L volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

D. Qualification Data: For qualified arborist and tree service firm.

E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
b. Enforcing requirements for protection zones.
c. Arborist's responsibilities.
d. Field quality control.

1.6 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Stockpiled topsoil from location shown on Drawings. Imported or manufactured topsoil complying with ASTM D 5268.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Ground or shredded bark.
2. Size Range: 76 mm maximum, 12 mm minimum.
3. Color: Natural.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain as indicated on drawings. Tie a 25-mm blue-vinyl tape around each tree trunk at 1372 mm above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones that are within 6 m of each disturbance or other construction activity.

1. Apply 101 mm average thickness of organic mulch. Do not place mulch within 152 mm of tree trunks.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

B. Maintain protection zones free of weeds and trash.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

D. Maintain protection-zone fencing in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in "Earth Moving" specification.

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 76 mm back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 38 mm in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.

5. Backfill as soon as possible according to requirements in specification Section "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune roots 304 mm of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.

B. Chip removed branches and stockpile in areas approved by Architect.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 50 mm or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed root cutting and tree and shrub repairs.
2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
4. Perform repairs within 24 hours.
5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size and species as those being replaced for each tree that measures 101 mm or smaller in caliper size.
2. Provide 3 new tree(s) of 101 mm caliper size for each tree being replaced that measures more than 150 mm in caliper size.

    a. Species: Species selected by Architect.

3. Plant and maintain new trees as specified in Division 32 Section "Plants & Planting”.

C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 76 mm to tree trunk. Drill 2-inch diameter holes a minimum of 304 mm deep at 609 mm o.c. Backfill holes with an equal mix of augered soil and sand.

D. Wetland Plant Removal, Storage and Replanting: Wetland plants in excavation zones are to be removed, roots well maintained and stored in a designated area on the site. Plants are to be reintroduced to the wetland in places determined by the landscape architect upon completion of wetland excavation.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1. SUMMARY

B. Work Included: The Work of this Section includes, but is not limited to the following:

1. Product delivery, storage, and handling.
2. Product warranties.
3. Product selection procedures.
4. Comparable products.

1.2 ACTION SUBMITTALS

A. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.5 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in Division 01 Section "Substitution Procedures" to obtain approval for use of an unnamed product.
7. Limited or no availability of products in local market does not remove Contractor's responsibility to obtain an "or equal" or "or approved equal", or "or approved" for Architect's approval.

B. Product Selection Procedures:

1. Product: Where Specifications or Drawings name a single manufacturer and product, provide the named product or equal and approved that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications or Drawings name a single manufacturer or source, provide a product by the named manufacturer or equal and approved source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Basis-of-Design Product: Where Specifications or Drawings name a product, and include a list of products or manufacturers, provide the basis of design product or equal and approved product. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in Division 01 Section "Substitution Procedures" for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

2.3 MATERIALS, WORKMANSHIP AND TESTING

A. Materials and Workmanship:

1. All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the A/E's instructions and shall be subjected from time to time to such tests as the A/E may direct at the place of manufacture or fabrication, or on the Site or at all or any of such places. The Contractor shall provide such assistance, instruments, machines, labor and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any materials used and shall supply samples of materials before incorporation in the Works for testing as may be selected and required by the A/E. All testing equipment and instruments provided by the Contractor shall be used only by the A/E or by the Contractor in accordance with the instructions of the A/E.
2. Material's that do not conform with the Specifications in the Contract may not be used for the Works without prior written approval of the Owner and the Architect, provided that the use of such material does not result in an increase in the Contract Price.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of work by Owner.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use Architect approved materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.

3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner and Architect that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for interpretation to Architect according to requirements in Division 01 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

D. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 27 deg C.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning

materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 business days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

4. Submit test/adjust/balance records.
5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 business days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Advise Owner of changeover in heat and other utilities.
6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Complete final cleaning requirements, including touchup painting.
9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 business days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

E. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

    a. When more than one reinspection is required, pay for Architect's Inspector's time to complete additional reinspections.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use Architect approved form in Project Manual.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format: MS Excel electronic file.

    1) PDF electronic file. Architect return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive A4 paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum soft flooring surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Revise subparagraphs below to suit Project.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents.

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold A4 paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.

4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures,

maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

G. Comply with Division 01 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints with one set of full color PDF electronic files of scanned marked-up set.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints.

b. Final Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints.

3. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

B. Record Specifications: Submit one paper copy with one set of full color PDF electronic files of scanned marked-up set of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy with one set of full color PDF electronic files of scanned marked-up set of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or [**Construction**] Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark information that was omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
3. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect**.**
    e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, record Product Data, and record Drawings where applicable.
5. Record Digital Data Files: Organize digital data information into book-marked binder PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project record documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning
    e. Procedures for preventive maintenance.

f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Architect with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to or other format file type acceptable to Owner, on electronic media.

C. Narration: Describe scenes on video recording by dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900

SECTION 033000 – CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Foundations
2. Slabs on grade
3. Columns
4. Beams

1.3 SUBMITTALS

A. Contractor means and methods must be approved by the assigned IU representative prior to start of construction

B. Product Data: Any request for product substitution must receive approval from the assigned IU representative, with documentation prior to time of bid. Requests for substitutions may not be considered after bids have been received.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Submit proof, either (1) results of performance on past projects or (2) concrete test results that concrete mixture will achieve the specified design strength.
1. Indicate amounts of mixing water to be withheld for later addition at Project site.

1.4 SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Waterstops.
5. Curing compounds.
6. Floor and slab treatments.
7. Vapor retarders.
8. Repair materials.

B. Material Test Reports: For the following, from a qualified Testing Agency, indicating compliance with requirements indicated based upon comprehensive testing of materials. Clearly state ASTM standards with which product or material complies:
1. Mill test reports for steel reinforcement.
2. Mill test reports for welded wire fabric.

3. Cement.
4. Aggregates.

Note: where material test reports are not available for items required in Part B, material testing must be provided by contractor.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.5 CONCRETE MIX DESIGN

A. General: Concrete Supplier to prepare concrete mix designs from representative samples of the materials to be used to produce the concrete for each "type" of concrete required.
1. A new "type" of concrete exists whenever any one or more of the following parameters change:
   a. Source or kind of any ingredient.
   b. Type or source of cement.
   c. Design strength.
   d. Proportioning of ingredients.
   e. Placing method (pumping vs. gravity).
2. The Concrete Supplier shall design or verify mixes for each "type" of concrete in accordance with the trial mixture method or field experience method of ACI 318M Article 5.3. Test results of trial mixes shall be submitted to Engineer for acceptance prior to concreting.
3. The proportion of ingredients shall be selected by the Concrete Supplier to produce proper place ability, durability, strength, and to produce a mixture which will work readily into the corners and angles of forms and around reinforcement by methods of placement and consolidation employed on the work, but without permitting materials to segregate or permitting excessive free water to collect on surface.
4. When a source, type, kind or brand of each constituent has been established and approved for the project mixes, it shall not be changed throughout the duration of the concreting. Batch all constituents including admixtures at the central batch plant.

B. Mix Requirements: Concrete mixes shall be designed to provide for all of the requirements given in this Specification and on the Drawings even if strength or any other criteria must be exceeded to meet other criteria.
1. Strength requirements given on the Drawings shall be based on 28-day compressive strength
2. Normal weight concrete shall have a cement content (per cubic meter) between 350 kg and 370 kg, and a maximum water-to-cement ratio, by weight, of 0.40 and a minimum strength of 24 MPa.
3. Concrete to be exposed to brackish water, or to salt laden air in service shall have a maximum water-to-cement ratio, by weight, of 0.40, a minimum strength of 24 MPa, a minimum cement content of 386 kg per cubic meter, air entrainment, Type II cement, and a maximum water soluble chloride ion content of 0.15 percent by weight of cement.
4. All concrete required to be watertight shall have a maximum water-to-cement ratio, by weight, of 0.40 and a minimum strength of 24 MPa. Water tanks walls and roofs, sump pits and columns submerged in water are required to be watertight.
5. All trowel finished interior slabs subjected to vehicular traffic, shall have a maximum water-to-cement ratio, by weight, of 0.40 and a maximum air content of 3%.
6. Provide pea gravel aggregate concrete for all sections thinner than 150 mm, and where required due to congestion of reinforcing steel.
7. Concrete mixes to be exposed to earth or weather shall have a maximum water soluble chloride ion content of 0.30 percent by weight of cement.
8. For all concrete exposed to view, a successful test placement must be made onsite to establish a satisfactory finish, joints, sealing, and polishing procedure. The test placement must be at least 18.6 sq. m, and preferably much larger, or as specified by the Architect or the Engineer.

1.6 QUALITY ASSURANCE: INSPECTION AND TESTING

A. Manufacturer Qualifications: A supplier experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Reinforcement Detailer Qualifications: A firm experienced in the preparation of reinforcement drawings for projects of a similar type, scale and complexity. Firm to have Qualified Professional Engineer employed, responsible for the review of reinforcement drawings, prior to issue.

E. Deficiencies: Deficient work and work not in conformance with the Contract Documents shall be repaired or replaced at Contractor's expense.

1.7 MEASUREMENTS AND TOLERANCES

A. Tolerances for Formed Surfaces: All tolerances shall apply to the full height of the building. Variations from grade shall be measured prior to removal of formwork.
   1. Exposed corner columns for any 20ft (6m) of length: +/- 1/4in (0.64cm)
   2. Exposed corner columns over entire length: +/- 1/2in (1.3cm)
   3. Variation in cross-section of columns and beams: +/- ½ in (1.3cm); -1/4in (0.64cm)

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel reinforcement must be delivered, stored, and handled in a way to prevent bending and damage. Contact with grease, oil, dirt and other objectionable materials must be avoided.

B. Ready mixed concrete shall be mixed and delivered in accordance with ASTM C94/C94 M. Furnish batch ticket information, indicating project identification name and number, date, mix type, mix time, quantity of concrete, weights and volumes of ingredients, and amount of water introduced. Concrete shall be placed within 90 minutes after start of mixing.

C. Cement must be stored off the floor in a dry room, well protected from rain. Deteriorated or contaminated materials shall not be used for concrete.

D. Store water stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301 (ACI 301M).
   2. ACI 117 (ACI 117M).
   3. ACI 318.

2.2 FORM FACING MATERIALS

A. General: The Section pertains to non-architecturally exposed surfaces only.

B. Smooth-Formed Finished Concrete: Forms for exposed finished concrete shall be made with form-facing panels that will provide continuous, straight, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, metal-framed plywood faced or other approved panel type materials.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Oil: Shall not contain castor oil.

E. Form Ties: Factory-fabricated, removable, or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 25 mm to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 25 mm in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed. Notify the assigned IU representative to verify rebar quantity is still adequate with the building design given a lower stress. Refer to submittal section reinforcing bar material certification required.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

A. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type I/II grey
   2. Fly Ash: ASTM C 618, Class F.
   3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
   4. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, portland blast-furnace slag Type IP, portland-pozzolan Type IT, ternary blended cement.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded, from a single source.
   1. Maximum Coarse-Aggregate Size: 20mm (3/4 in) nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

D. Water: ASTM C 94/C 94M and potable.

2.5 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

2.6 CONCRETE MIXTURES, GENERAL

A. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.
   6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

2.7 VAPOR RETARDER

A. Sheet Vapor Retarder: 10mm min ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.8 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Typical proportion normal-weight concrete mixture as follows for Beams, Columns, and Suspended Slabs:
   1. Class A: 1:1.5:3 mix proportion by volume.
   2. Minimum Compressive Strength: 24Mpa (3.5 ksi) at 28 days.
   3. Maximum Water-Cementitious Materials Ratio: 0.40.
   4. Slump Limit: 50-100mm (2 to 4 in)

B. Typical proportion normal-weight concrete mixture as follows for Foundations, Slab on Grade:
   1. Class B: 1:2:4 mix proportion by volume
   2. Minimum Compressive Strength: 15Mpa (2.2 ksi) at 28 days.
   3. Maximum Water-Cementitious Materials Ratio: 0.40.
   4. Slump Limit: 50-100mm (2 to 4 in)

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits per this specification.

C. Limit concrete surface irregularities, as abrupt or gradual, as follows:
   1. Class A, 3mm (1/8 in) for exposed concrete surfaces.
   2. Class B, 6mm (1/4 in) for concrete surfaces not exposed to view.

D. Construct forms tight enough to prevent loss of concrete mortar. Seal edges to prevent staining of adjacent vertical surfaces.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete. Chamfer shall be 20mm

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete. Permanent marker and wax shall not be used on formwork for layout purposes. Formwork markings transferred to concrete shall be removed from surfaces exposed to view.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 POST INSTALLED ANCHORS

A. Install post installed anchors according to manufacture requirements for securing building services to cast-in-place concrete.
   1. Epoxy and chemical resin anchors are not permitted to in applications to resist direct tension loads.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength. Do not apply additional loading to slabs until 100 percent of 28-day strength is achieved without prior approval of Design Professional.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Design Professional.

3.5 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301, ACI 347R and ACI 117 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, and other foreign materials that would reduce bond to concrete.

C. Reinforcing steel must have specified concrete cover over reinforcement. Rebar must be inspected prior to concealing with formwork to ensure proper cover, rebar type, spacing, splices and quantity is stalled correctly as shown.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Any required control or expansion joints, as specified by construction drawings, must be installed so that the strength of the concrete is not impaired.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 40mm (1-1/2 in) into concrete. Keys shall be continuous unless specified otherwise.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible. Intervals shall be 4.5 AND 7.5m (15 and 25 ft)where possible, with a maximum spacing not to exceed 12m (40 ft), not to be located within 7.5m (15 ft) of a wall corner.
   6. Leave 7 days, minimum, between adjacent pours of wall construction.
   7. Reinforcing bars should run continuously through joints as indicated in the structural drawings.
   8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 3mm (1/8 in). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3mm (1/8 in) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.8 WATERSTOP INSTALLATION

A. Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 (ACI 301M).

C. Non-Continuous Pours: Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with epoxy bonding agent, and place dowels as required by the Design Professional. Contractor to submit details of emergency construction joint method prior to commencement of site work.

3.10 FINISHING FLOORS AND SLABS

A. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 6mm (1/4 in) in one direction.
   1. Apply scratch finish to surfaces indicated to receive concrete floor toppings.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
   2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 3.05-m- (10-ft.-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 6mm (1/4 in).

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
   1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Cure concrete according by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 300mm (12 in), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:
   1. Steel reinforcement placement and supporting devices. Contractor shall not be permitted to place concrete until reinforcing steel has been inspected and approved, including the inspection of all embeds and mechanical coupling devices.
   2. Headed bolts and studs.
   3. Verification of use of required design mixture.
   4. Concrete placement, including conveying and depositing.
   5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained shall be performed according to the following requirements (note- requirements in accordance with according to ASTM C 172):
   1. Testing Frequency: Obtain at least one composite sample for each 38 cubic meters (50 cubic yards) or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: (ASTM C 143/C 143M) one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: (ASTM C 231 pressure method) for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: (ASTM C 1064/C 1064M) one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: (ASTM C 567), fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: (ASTM C 31/C 31M)
   a. Cast and laboratory cure three sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: (ASTM C 39/C 39M)
   a. Test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   b. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 3.5MPa (500 psi).
10. Test results shall be reported in writing to Design Professional, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Design Professional but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Design Professional. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Design Professional.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents

END OF SECTION 033000

SECTION 033521 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polished concrete floor finishes.

1.2 PERFORMANCE REQUIREMENTS

A. Finished floor system shall achieve slip-resistance equal or greater to “High Traction” rating of the National Flooring Safety Institute rating system, as tested in conformance with ANSI B101.3.

1.3 SUBMITTALS

A. Product Data for polishing and grinding equipment and abrasives.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with minimum 5 years experience in the production of specified products.

B. Installer Qualifications: Installer who is certified by manufacturer for application of products required for this Project. Installer shall be certified by concrete finish equipment and floor system manufacturers and shall provide adequate number of workers thoroughly trained, skilled, and experienced in the Work.

C. Comply with requirements of The Concrete Society of Southern Africa NPC (CSSA).

D. Notify manufacturer's authorized representative minimum one week prior to start of the Work.

E. Preinstallation Conference: Conduct conference at Project site.

1.5 MOCKUP

A. Mockup minimum 10 feet by 10 feet at 4 locations as directed by Architect. Construct mockup using materials, processes, and techniques as options to be used on permanent work, including curing procedures, edges, and expansion joints. Finish options to be included in 4 mockups as follows:

1. Class A: Cream finish – polishing only the Portland cement paste at the surface without exposing small, medium or large aggregate. Level 2 Sheen, Satin, with gloss reading of 10-25 (100-400 grit).

2. Class A: Cream finish – polishing only the Portland cement paste at the surface without exposing small, medium or large aggregate. Level 3 Sheen, Semi-polished, with gloss reading of 25-70 or higher (800 grit, or higher).
3. Class B: Fine Aggregate (Salt & Pepper) finish - Expose the fine aggregate such as sand and small aggregate with the concrete. Level 2 Sheen, Satin, with gloss reading of 10-25 (100-400 grit.
4. Class B: Fine Aggregate (Salt & Pepper) finish - Expose the fine aggregate such as sand and small aggregate with the concrete. Level 3 Sheen, Semi-polished, with gloss reading of 25-70 or higher (800 grit, or higher).
5. Retain samples of products and additives used in mockup for comparison with materials used in permanent Work.

B. Mockup shall remain as a quality standard through completion of the Work.

C. Remove mockups as and when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting floor system performance.

1. Place floor system components only when ambient temperature and other environmental conditions of substrates are within ranges recommended by manufacturer's written instructions.
2. Protection: Protect floor with non stain kraft paper and rigid sheeting. Allow concrete to cure a minimum of 28 days.

PART 2 - PRODUCTS

2.1 CONCRETE FINISHING SYSTEMS

A. Basis of Design Products: Subject to requirements provide Permashine conditioned ground and polished concrete finishing system manufactured by Laticrete International, Inc. as Basis of Design, or Architect approved comparable products.

B. System Description:

1. Hardener, sealer, and Densifier: Consisting of a water based, odorless liquid, VOC compliant environmentally safe chemical hardening solution that leaves no surface film.

a. Basis of Design Product: FGS Hardener Plus.

2. Joint Filler: Semi-rigid, two component, self-leveling, 100% solids, polyuria control joint filler, Shore A 80 or higher.

a. Basis of Design Product: Joint Tite 750.

3. Sealer: Silane, siloxane, and fluoropolymer blended water based solution, fast drying, low odor, VOC compliant, compatible with chemically hardened floor.

a. Basis of Design Product: Petrotex.

4. Cleaning Solution: Product recommended by system manufacturer.
5. Stain Guard Sealer: Low odor, VOC compliant protectant coating against staining of floor.

a. Basis of Design Product: Permaguard SPS.

6. No substitutions of individual system materials permitted unless approved in writing by flooring system manufacturer.

C. Finish Type:

1. As selected from finish options indicated above.
2. Color: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. All other components or products recommended by manufacturer and required to complete floor system installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting grinding or final performance.

1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

B. Grind Level: Light grind in conformance with manufacturer's recommendations to achieve specified finish.

C. Fill construction joints and cracks with filler products as specified in accordance with manufacturer’s instructions, colored to match with concrete color as specified by architect.

3.3 APPLICATION

A. General: Mix and apply components according to manufacturer's written instructions.

B. Grind substrate at intervals and at levels as recommended by manufacturer to achieve specified finish.

C. Apply material approved by architect for color effects in accordance with the architectural drawings and the manufacturer’s recommended guidelines.

D. Apply densifying material at application rate recommended by manufacturer. Remove excess material and allow for full cure of materials.

E. Apply finish coats at application rate recommended by manufacturer. Following full cure of final coat, buff or polish surface per manufacturer's recommendations.

F. Provide access for inspection by Architect and manufacturer's authorized representative.

3.4 CLEANING

A. Clean area and substrate regularly. Keep area clear of debris, dust, and contaminants.

B. Remove dust and slurry or spillage from adjacent surfaces as required.

C. Dispose of debris and containers in accordance with local regulations.

END OF SECTION 033521

SECTION 042000 – UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes but is not limited to the following:
Extent of masonry wall work is indicated on plans. Type of masonry includes:
1. Concrete unit Masonry
2. Brick Masonry

1.3 SUBMITTALS

A. Product Data: submit manufacturer's product data for each type of masonry unit, accessory and other manufactured products

B. Contractor means and methods must be approved by the assigned IU representative prior to start of construction.
1. Samples for Verification Purposes: submit a unit masonry sample for each type of exposed masonry unit and texture to be expected in completed work.
2. Include size variation data verifying that actual range of sizes for brick falls within ASTM C216 dimension and tolerances for modular brick.

1.4 QUALITY ASSURANCE
1. Obtain prefabricated units or cementitious materials from a single manufacturer. Where it is not possible to obtain material from one source, cementitious material must have uniform quality and be approved by assigned IU representative.
2. Field constructed Mock-Ups: Prior to installation of masonry work, erect representative sample wall panels to further verify selections made for color and texture characteristics, under sample submittals of masonry materials, construction and workmanship. Mockups to be approximately 2m long by 3m high.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Five percent or less of a shipment containing chips, not larger than 25mm (1in) in any dimension, and not longer than 25% of the nominal height of unit is acceptable. Material must be discarded if chips larger than acceptable dimensions.
1. All units must be sound and free of cracks or other defects that interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction.

B. All units must be stored off the ground, under cover and in dry locations to prevent deterioration. Limit moisture absorption of concrete masonry units during delivery and until time of installations

C. Store cementitious materials off the ground, under cover and in a dry locations.

D. Store and protect aggregates where grading and other required characteristics can be maintained.

E. Store and protect masonry accessories including metal items to prevent deterioration by corrosions and accumulation of dirt.

F. Protection of Work: During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1. Extend cover a minimum of 24" down both sides and hold cover securely in place.

G. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.

H. Do not apply concentrated loads for at least 3 days after building masonry wall or columns.

I. Protect base of walls from rain – splashed mud and/or mortar spatter by means of coverings spread on ground and over wall surfaces.

J. Protect Sills, ledges, and projections form droppings of mortar.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

1. Obtain masonry units from one manufacturer, of uniform strength, texture and color for each kind required, for each continuous area and visually related areas.

2.2 CONCRETE MASONRY UNITS

A. Provide special shapes where required for lintels, jambs, corners, sash, control joints, headers bonding and other special conditions

B. Concrete Block: Provide units complying with characteristics indicated below for Face Size, Exposed Face, and under each form of block included for weight classification.
   1. Size: Manufacturer's standard units with nominal face dimensions of (400mm long x 200mm high x thickness indicated)
   2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150psi (14.8MPa)
   3. Density Classification: Nomral Weigth
   4. Curing: CMU's must kiln or air cured under cover until the age of the blocks is at least 10 days.
   5. Production: Blocks shall be manufactured using an approved machine and shall have minimum crushing strength of 4.0 N/sq mm of gross area at 28 days. The blocks shall be composed of 1:6 cement sand measured by volume unless otherwise specified or directed on the site, turned three times dry, until of even color and consistency throughout. Water shall then be added gently from a watering can through a hose, the quantity of water added being just sufficient to secure adhesion

2.3 MORTAR AND GROUT MATERIALS

A. General: Use only the specified additives to mortar and grout mixes.
   1. Do not use calcium chloride in mortar or grout

B. Mixing: Combine and thoroughly mix cementitious materials, water, aggregates and admixture in a mechanical batch mixer. Comply with applicable ASTM standards and material manufacturer's recommendations for mixing time and water content. Measure and batch materials by volume so that required proportions can be accurately controlled and maintained.

C. Mortar for Unit Masonry: Comply with ASTM C-270, Proportion Specifications, Cement-Lime Mortar, for types of mortar required, unless otherwise indicated.
   1. Mortar should be compatible with the blocks, ie it should have similar or lower compressive strength and erosion resistance.
   2. Cement mortar shall be composed of one part of cement to three parts of sand. Mortar must be mixed mechanically. The mortar must be used within one hour of the addition of the mixing water.
   3. Use Type N mortar for non-load bearing walls.
      a. Air Content: 8-24% Maximum.
   4. Use Type N, S, or M mortar for load bearing walls.
      a. Air Content: 8-19% Maximum.

D. Limit Cementitious materials in mortar to Portland cement-lime.

E. Grout for Unit Masonry: Comply with ASTM C-476. Use grout of consistency which at time of placement will completely fill all spaces intended to receive grout
   1. Cement-Sand Mixes of 1:4 or 1:6 must be used for walls. Use grout of consistency which at time of placement will completely fill all spaces intended to receive grout.
   2. Mix: Portland cement, sand, gravel and water, proportioned as required to provide a 28-day minimum compressive strength of 20 MPa (3000 psi)
   3. Use for reinforced masonry lintels or bond beams, reinforced masonry piers, and wherever grouting full is indicated or specified.

2.4 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A185, plain, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A497, flat sheet.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."
   1. exceeding 10 percent.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to the start of masonry construction the Contractor shall verify:
   1. Foundations are constructed with tolerances conforming to ACI 117
   2. Reinforcing dowels are positioned in accordance with Project Drawings.

3. Verify items provided by other Sections of the Work are properly sized and located

B. If conditions are not met, notify the Architect

3.2 PREPARATION

A. Establish Lines, Levels, and Coursing
   1. Protect lines from disturbance
   2. Use non-corrosive material in contact with masonry

B. Surface preparation: Prior to placing Concrete Masonry remove laitance, loose aggregate or other material that would prevent mortar from bonding to the foundation

3.3 COURSING

A. Uniformity: Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness

B. Bond Patterns: Place Concrete Masonry in 1/2 running bond unless otherwise noted

C. Course Height: Course one Concrete Masonry and one mortar joint equal to 200 mm (8 in)

3.4 PLACING AND BONDING

A. Bed and Head Joints
   1. Joint Thickness:
      a. Construct 10mm (3/8 in) bed and head joints unless otherwise indicated
      b. Construct bed joint at starting course on foundation not less than 6mm (1/4 in) and not more than 20mm (3/4 in)
   2. Fill holes not specified in exposed and below grade masonry with mortar
   3. Tool head and bed joints concave unless below grade or above ceiling height and to be concealed
      a. Use tool with large enough radius that joint is not raked free of mortar
   4. Remove masonry protrusions extending 12mm (1/2 in) or more into cells and cavities to be grouted

B. Unit Placement
   1. Concrete Masonry Unit- Lay units with bed and head joints filled from the faces of the units to a distance in not less than the thickness of the face shell
      a. Webs are fully mortared in all courses of piers, columns, pilasters, starting course on footings or foundations, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
      b. Spread out full mortar bed including areas under cells, for starting course on footings where cells are not to be grouted
      c. Vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with drawings
   2. Keep cavity airspace and weep holes clean or mortar, clean out promptly if mortar falls into cavity airspace or plugs weep holes
   3. In-Progress Cleaning
      a. Remove excess mortar
      b. Dry brush exposed masonry prior to the end of each workday
      c. Protect wall from mud splatter and mortar droppings
         1) Set scaffolds and scaffold boars so that mortar is not deflected onto masonry

2) At end of each workday turn scaffold boards so that rainwater is not deflected onto masonry.

d. Place Concrete Masonry Unit such that mortar does not run down the face of the wall or smear the masonry face

4. Adjustments
   a. Do not shift or tap Concrete Masonry Unit after mortar has taken initial set
   b. Remove unit and mortar and replace
5. After joints are tooled, cut off mortar tailings with trowel and dry brush excess mortar burrs and dust from the face of the masonry
6. Fully bond external and internal corners and properly anchor intersecting wall
7. Termination of Wall Height:
   a. For the fire-rated walls, construct walls to finish against bottom of roof or floor deck and fill voids in fire stopping
   b. For other than fire-rated walls, cut units to match the slope of the roof deck and finish construction to within 2-inches of a parallel to roof deck
8. Isolate masonry partitions from vertical structural framing members with the control joint.

3.5 TOLERANCES

A. Dimensions of Elements
   1. In cross-section or elevation: -6mm (-1/4 in), 12mm (+1/2 in)
   2. Mortar joint thickness
      a. Bed: Plus or minus 3mm (1/8 in) or plus 3mm (1/8 in)
      b. Head: plus 10mm (3/8 in) or minus 6mm (1/4 in)
      c. Collar: plus 10mm (3/8 in) or minus 6mm (1/4 in)
   3. Grout space or cavity airspace except where passing framed construction: plus 10mm (3/8 in) or minus 6mm (1/4 in)

B. Elements
   1. Variation from level
      a. Bed joints: plus or minus 6mm (1/4 in) 3m (10 ft); plus or minus 12mm (1/2 in) maximum.
      b. Top of bearing walls: plus or minus 6mm (1/4 in) 3m (10 ft); plus or minus 12mm (1/2 in) maximum
   2. Variation from plumb: plus or minus 6mm (1/4 in) 3m (10 ft);, plus or minus 10mm (3/8 in in 6m (20 ft), plus or minus 1/2 inch maximum
   3. True to line: plus or minus 6mm (1/4 in) 3m (10 ft); plus or minus 10mm (3/8 in) in 6m (20 ft); plus or minus 12mm (1/2 in)maximum
   4. Alignment of columns and walls (bottom versus top):
      a. Bearing: plus or minus 12mm (1/2 in)
      b. Non-bearing: Plus or minus 20mm (3/4 in)

C. Locations of Elements
   1. Indicated in plan: plus or minus 12mm (1/2 in) in 6m (20 ft); plus or minus 20mm (3/4 in) maximum
   2. Indicated in elevation: plus or minus 12mm (1/2 in) in story height; plus or minus 20mm (3/4 in) maximum

D. Notification: If the above conditions cannot be met due to previous construction notify Architect/Owner's Representative

3.6 CUTTING AND FITTING

A. Coordination: Cut and fit for bearing plates, chases, pipes, and conduits, sleeves and grounds. Coordinate with other Sections of Work to provide correct size and shape.

B. Notification: Prior to cutting and fitting any area not indicated or where appearance or strength of masonry work may be impaired, obtain approval from Architect/ Owner's Representative.

C. Cutting Method: Perform jobsite cutting with proper tools to provide straight un-chipped edges and take care to prevent raking masonry unit corners or edges

3.7 REINFORCEMENT AND ANCHORAGES

A. Basin Requirements
1. Place reinforcement and anchorages in accordance with the sizes, types, and locations indicated on the Drawings, and as specified.
2. Do not place dissimilar metals in contact with each other

B. Details of Reinforcement
1. Completely embed reinforcement in grout in accordance with Article3.08
2. Maintain clear distance between reinforcing bars and any face of masonry unit or formed surfaces:
   a. Not less than 6mm (1/4 in) for fine grout
   b. Not less than 12mm (1/2 in) for coarse grout.
3. Splice only where indicated on Drawings, unless otherwise specified
4. Do not bend reinforcing bars after embedded in grout
5. Place vertical reinforcing bars supported and secured against displacement by means of bar positioners
6. Support bars other than vertical bars and tie to prevent displacement
7. Placement tolerances
   a. Place vertical reinforcing bars within 50mm (2 in) of required location along the length of the wall

C. Joint Reinforcement
1. Placement
   a. Install joint reinforcement at 400mm (16 in) on center vertically, except space at 200mm (8 in) on center in parapet walls and below finished floor unless otherwise indicated on Drawings
   b. Place joint reinforcement continuous in first bed joints below top of masonry wall and bed joint 200mm (8 in) below first bed joint below top of wall
   c. Place joint reinforcement so that longitudinal wire are embedded in mortar
   d. Do not extend joint reinforcement through control joints

D. Wall Ties
1. Embed ends of wall ties in mortar joints at least 12mm (1/2 in) into outer face shell of hollow masonry construction
2. Unless otherwise provided, install additional unit ties around all openings larger than 200mm (16in) in either dimension. Space ties around the opening at a maximum of 1m (3 ft) on center and place ties within 300mm (12 in) of the opening.

3.8 BUILT IN AND EMBEDDED ITEMS AND ACCESSORIES

A. Incorporation: As work progresses build in metal doorframes, fabricated metal frames, window frames, anchor bolts, diaphragm anchors, embedded plates, and other items in the work supplied in other Sections

B. Organic Materials: Do not build in organic materials subject to deterioration

3.9 GROUT PLACEMENT

A. Placement
   1. Place grout within 1-1/2 hours of introducing of mixing water and prior to initial set
   2. Prevent grout from flowing onto or otherwise staining faces of CMU intended to be exposed.

B. Grout Height: Place grout in lifts not to exceed 1.5m (5 ft)

C. Consolidation: Consolidate grout at the time of placement
   1. Consolidate grout pours 300mm (12 in) or less in height by mechanical vibration or puddling
   2. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred

3.10 BRACING

A. Design and Installation: Design, provide and install bracing for walls, lintels and other masonry work that will assure stability of masonry during construction

B. Duration: Maintain bracing in place until roof or other structural elements are complete and provide permanent support

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

END OF SECTION 042000

SECTION 042400 – COMPRESSED STABILIZED EARTH BLOCK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:
Extent of masonry wall work is indicated on plans. Type of masonry includes:
1. Compressed Stabilized Earth Block (CSEB)
2. Mortar and grout
3. Miscellaneous masonry accessories.

1.3 SUBMITTALS

A. Product Data: submit manufacturer's product data for each type of CSEB mixture, accessory and other manufactured products

B. Contractor means and methods must be approved by the assigned IU representative prior to start of construction.
1. Samples for Verification Purposes: submit a CSEB sample for each type of exposed masonry unit and texture to be expected in completed work.

1.4 QUALITY ASSURANCE
1. Obtain cementitious stabilizer materials from a single manufacturer. Where it is not possible to obtain material from one source, cementitious material must have uniform quality and be approved by assigned IU representative.
2. If not constructed on site, obtain prefabricated units from a single manufacturer.
3. Field constructed Mock-Ups: Prior to installation of masonry work, erect representative sample wall panels to further verify selections made for color and texture characteristics, under sample submittals of masonry materials, construction and workmanship. Mockups to be approximately 2m long by 3m high.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Upon completion of curing, blocks must be stored in a safe location to prevent weathering or damage. Blocks must remain covered and protected from the elements.

B. If transported, blocks should be moved flat and laid on a bed of sand for protection
1. Blocks must not be cracked or broken during storage or transportation. If damaged, blocks must not be used for construction.

C. Store cementitious materials off the ground, under cover and in a dry locations.

D. Store and protect aggregates where grading and other required characteristics can be maintained.

E. Store and protect masonry accessories including metal items to prevent deterioration by corrosions and accumulation of dirt.

F. Protection of Work: During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

1. Extend cover a minimum of 24" down both sides and hold cover securely in place.

G. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.

H. Do not apply concentrated loads for at least 3 days after building masonry wall or columns.

I. Protect base of walls from rain – splashed mud and/or mortar spatter by means of coverings spread on ground and over wall surfaces.

J. Protect Sills, ledges, and projections from droppings of mortar.

PART 2 - PRODUCTS

2.1 CSEB UNITS, GENERAL

1. Obtain masonry units from one manufacturer, of uniform strength, texture and color for each kind required, for each continuous area and visually related areas.

2.2 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacture for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source of producer for each aggregate.

2.3 SOIL

A. Only soils mixes with ideal compositions may be used when producing CSEBs. Organic matter must not be used.

B. The following soils are unsuited to make earth blocks (Structural Guidance Note, Unfired earth Blocks, 2013). Confirm soil with geotechnical engineer classifications are suitable for use.

Cement-stabilised	Topsoils Organic matter content greater than 1% to 2% Highly expansive soils Soils with soluble salts in sufficient quantities to impair strength or durability (found by trial testing).
Bitumen-stabilised	Topsoils Highly expansive soils Alkaline soils Soils with high organic matter and sulphate content Soils with mineral salt content sufficient to impair strength and durability; proposed limit 0.25%.
Lime-stabilised	Topsoils Soils with combined clay + silt content less than 30% Organic matter content in excess of 20% Soils with excessive sulphates.

C. Soil mix ratios must be approved by the assigned IU representative prior to any construction

2.4 STABILIZING ELEMENT

A. General: Use only the specified additives to mortar and grout mixes.
   1. Do not use calcium chloride in mortar or grout

B. Whenever possible, cement should be used as the added stabilizing element. While cement is the recommended stabilizer, in cases of soils with high clay content, industrial grade lime can be used.

C. The amount of cement required to achieve CSEBs of acceptable compressive strength varies with soils composition.
   1. An optimal soils composition for cement stabilization is 20% clay, 15% silt, 50% sand, 15% gravel
   2. An optimal soils composition for lime stabilization is 35% clay, 20% silt, 30% sand, 15% gravel

D. Soil must be prepared by sieving to ensure proper granular size of particles. Particles above 10mm and all lumps must be removed.

E. Provide sealant admixture to decrease soil permeability and treated with UV inhibitors.

2.5 CURING

A. Blocks must be properly cured for 28 days
   1. Immediately after removal from the press, blocks must be stacked in piles nearby for 3 days. These piles must remain covered with a plastic tarp.
   2. Piles may be 7-8 blocks high, leaving approximately 50mm (2in) between piles
   3. Final stacking must occur in compact and organized piles of approximately 500 blocks, consisting typically of 6 layers of 85 blocks
      a. Ensure blocks remain flat when moved to final stacking and curing location on or after day 3

4. Piles must be covered with jute cloth or plastic tarps
5. Blocks must cure for a minimum 28 days, with water being added as needed to prevent full drying.

B. Blocks must be protected throughout curing. Blocks must remain free from cracks and broken edges. Erosion of the blocks due to curing or weathering must not exceed 10% of total block area and individual pits must not be larger than 3 mm.

C. Blocks must be tested to meet minimum strength requirements after curing as listed below. (MOHSW Infrastructure Standards)

Strength Requirements

Test results will show the strength of CSEBs produced. Blocks are divided into three classes: A, B, and C. Class A is of the highest quality; Class B is good quality; Class C is of moderate quality and should be carefully reinforced to ensure adequate performance. The performance class of a block is determined by its wet compressive strength.

Characteristics	Class A	Class B	Class C
Dry Compressive Strength	5 to 7 MPa	4 to 5 MPa	3 to 4 MPa
Wet Compressive Strength*	3 to 4 MPa	2 to 3 MPa	1.5 to 2 MPa
Dry Bending strength	0.5 to 1 MPa	0.4 to 0.8 MPa	0.3 to 0.6 MPa
Water absorption by weight	0.4 to 0.6 MPa	0.3 to 0.5 MPa	0.2 to 0.3 MPa
Block volumic mass	8 to 10%	10 to 12%	12 to 15%

D. Wall Lintels: Minimum 3,000 psi

2.6 BLOCK DIMENSION

A. Minimum Wall thicknesses are 200mm for external walls and 125mm for internal walls
1. Height of braced (not free standing) wall <= 10x thickness
2. Length of wall <= 30 x thickness

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to the start of masonry construction the Contractor shall verify:
1. Verify items provided by other Sections of the Work are properly sized and located

B. If conditions are not met, notify the Architect

3.2 PREPARATION

A. Establish Lines, Levels, and Coursing
1. Protect lines from disturbance
2. Use non-corrosive material in contact with masonry

B. Surface preparation: Prior to placing CSEBs remove laitance, loose aggregate or other material that would prevent mortar from bonding to the foundation

C. Uniformity: Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness
   1. Vertical joint spacing 3m-6m
   2. Lintel supports are required for openings > 250mm

3.3 MORTAR PLACEMENT

A. Placement
   1. Place grout within 1-1/2 hours of introducing of mixing water and prior to initial set
   2. Prevent mortar from flowing onto or otherwise staining faces of CSEB intended to be exposed.

3.4 BLOCK LAYING PRINCIPLES

A. The blockwork laying shall be carried out in a uniform manner. No one portion shall be raised more than 900mm above another at any time. The work shall be carried up course by course and the height of four courses when laid shall be 900mm. Bonding shall be common.

B. All internal and external faces shall have raked out joints for plaster unless otherwise specified.

C. Soak the blocks into water just before laying

D. Fill the vertical mortar joint when laying the block. Do not fill the joint after laying the block.

E. Do not adjust the block after laying
   1. For blocks not properly laid, remove the block and mortar and replace.

F. Follow the basic guidelines of masonry (tolerances and pattern)

3.5 SURFACE PROTECTION

A. Renders may be applied after the wall surface has been prepared and cleaned from dust to provide a good base.
   1. Renders may be applied in one or three coats, depending upon the required quality of surface finish.
   2. The second coat can be used to fill any cracks in the dried first coat

3.6 BRACING

A. Design and Installation: Design, provide and install bracing for walls, lintels and other masonry work that will assure stability of masonry during construction

B. Duration: Maintain bracing in place until roof or other structural elements are complete and provide permanent support

END OF SECTION 042400

SECTION 51200 – STRUCTURAL STEEL FRAMING

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:
   1. Structural steel.
   2. Grout

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer fabricator.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Shop primers.
   3. Non-shrink grout.

1.5 QUALITY ASSURANCE

A. The qualifications of the companies of individuals specializing in performing the work of this section must be reviewed and approved by the assigned IU representative.
   1. Includes the qualifications of: companies or individuals performing fabrication: companies or individuals performing the erection of structural and other major building members.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Contractor’s testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: As much as possible, provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
   1. W-Shapes: 60 percent.
   2. Channels, Angles: 60percent.
   3. Plate and Bar: 25 percent.
   4. Cold-Formed Hollow Structural Sections: 25 percent.
   5. Steel Pipe: 25 percent.
   6. All Other Steel Materials: 25 percent.

B. Channels, Angles, S-Shapes: ASTM A 36/A 36M (EN 10025 S235)

C. Plate and Bar: ASTM A 572/A 572M, Grade 36 (EN 10025 S235).

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing (EN 10025 S235)

E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

F. Welding Materials: Use low hydrogen electrode types a s much as possible

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325X (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

C. Unheaded Anchor Rods: ASTM F 1554, Grade 36
   1. Configuration: Straight and Hooked.
   2. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

E. Threaded Rods: ASTM A 36/A 36M.
   1. Finish: Plain Hot-dip zinc coating, ASTM A 153/A 153M, Class C deposited zinc coating, ASTM B 695, Class 50].

2.3 PRIMER

A. Immediately after surface preparation, apply primer according to manufacturer's written instructions to provide a minimum dry film thickness of 0.038mm.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time. (ASTM C 1107/C 1107M)

B. Nonmetallic, Shrinkage-Resistant Grout: factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time. (ASTM C 1107/C 1107M)

2.5 FABRICATION

A. Structural Steel: Where prefabricated structural steel is used, the fabrication of structural steel in one location, by one fabricator, must be prioritized to help provide additional consistency to structural strength.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according manufacturer's written instructions.

2.6 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 50 mm (2 in)
   2. Surfaces to be field welded.
   3. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   4. Galvanized surfaces.
   5. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M:

D. Prepare test and inspection reports

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

B. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Splice members only where indicated.

D. Do not use thermal cutting during erection.

E. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

B. Weld Connections: Surfaces on which weld metal is to be deposited must be smooth, uniform, and free from fins, tears, cracks and other discontinuities that would adversely affect the quality of strength of the weld.
   1. Welding electrodes thickness and current must be appropriate for base metal thickness.
      a. Plate thickness up to 5mm -1.5mm electrode diameter
      b. Plate thickness over 3mm – 3mm electrode diameter

   2. For structural welding, contractor must use E70xx low hydrogen electrodes. Where low hydrogen electrodes are not available, contractor must receive approval from assigned IU representative for a substitute product.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Contractor to engage a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Contractor to engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M as referenced by MOHSW Infrastructure Standards.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for toilet partitions.
2. Steel framing and supports for countertops.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Steel shapes for supporting elevator door sills.
6. Shelf angles.
7. Metal ladders.
8. Elevator pit sump covers.
9. Miscellaneous steel trim
10. Metal bollards.
11. Downspout guards.
12. Abrasive metal nosings.
13. Loose bearing and leveling plates for applications where they are not specified in other Sections.
14. Steel doors.
15. Steel windows.
16. Metal grating.
17. Blade spikes.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Metal nosings and treads.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Window and Door Shop Drawings: Provide large scale shop drawings for fabrication, installation, and erection of all parts of the work not fully described by Architect's Drawings. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

F. Zinc-Coated Steel Wire Rope: ASTM A 741.

G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and flat washers where indicated.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

E. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
3. Eyebolts: ASTM A 489.
4. Machine Screws: ASME B186.2 and ASME B18.67 M.
5. Lag Screws: ASME B18.2.3.8 M.
6. Plain Washers: ASME B18.22 M.

2.3 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Division 03 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 3.2 by 38 mm, with a minimum 150-mm embedment and 50-mm hook, not less than 200 mm from ends and corners of units and 600 mm o.c., unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

2.6 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 19-mm bolts, spaced not more than 150 mm from ends and 600 mm o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 50 mm larger than expansion or control joint.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 457 mm apart unless otherwise indicated.
2. Siderails: Continuous, 12.7-by-64-mm steel flat bars, with eased edges.
3. Rungs: 19-mm diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder at top and bottom and not more than 1500 mm o.c. with welded or bolted steel brackets.

2.8 ELEVATOR PIT SUMP COVERS

A. Fabricate from 4.8-mm abrasive-surface floor plate with four 25-mm diameter holes for water drainage and for lifting.

B. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 12 mm in least dimension.

C. Provide steel angle supports as indicated.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.10 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.

2.11 DOWNSPOUT GUARDS

A. Fabricate downspout guards from 9.5-mm thick by 300-mm wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 50-mm clearance between pipe and pipe guard. Drill each end for two 19-mm anchor bolts.

2.12 ABRASIVE METAL NOSINGS

A. Cast-Metal Units: Cast iron with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Nosings: Cross-hatched units, 100 mm wide with 25-mm lip, for casting into concrete.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

2.13 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.14 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 200 mm unless otherwise indicated.

C. Loose steel lintels located in exterior walls.

2.15 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

A. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete or masonry, or unless otherwise indicated.

B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099100 "Painting": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.18 STEEL DOORS AND FRAMES

A. Component Sizes: See Drawings. A mockup shall be produced and approved by the Architect before full production.

B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

C. Finish: Paint color as selected by Architect. Refer to Section 099100 "Painting".

D. Between all steel and glass connections clear silicon weather stripping must be installed.

E. All doors shall be of the types and sizes indicated and shall be fully welded seamless construction with no visible seams or joints on their faces or vertical edges. All such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface. All doors shall be rigid and neat in appearance, free from warp, age or buckle. Corner bends shall be true and straight, and of minimum radius for the gauge of metal used. Door faces shall be jointed at their vertical edges by a continuous weld extending the full height of the door. All such welds shall be ground, filled (mastiqued) and dressed smooth to make them invisible and provide a smooth flush surface. All steel doors and frames shall be thoroughly cleaned to remove all dirt and rust and chemically treated to insure maximum paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on, suitable as a base for finish paints.

F. Unless steel doors and frames are factory finish painted, two compatible coats of finish paint shall be applied in the field. The finish paint shall be of a type recommended for use on primed steel.

2.19 STEEL WINDOWS

A. Component Sizes: See Drawings for window types. A mockup shall be produced and approved by the Architect before full production.

B. General: The window frame is made out of square hollow section tube. A HSS stopper frame is welded on the exterior part of the operable window. The glass rest between two flat bars welded to the HSS. A putty is applied on the exterior part of the window. Provide a Z shapes steel plate installed at the top of the operable window in order to fight against rain. A flat bar is installed at the bottom of the operable window for the same purpose. A HSS is installed between operable and inoperable panels of a window. Between all steel and glass connections clear silicon weather stripping shall be installed.

C. Finish: Paint color as selected by Architect. Refer to Section 099100 "Painting".

D. Between all steel and glass connections clear silicon weather stripping must be installed.

E. All window assemblies shall be of the types and sizes indicated and shall be fully welded seamless construction with no visible seams or joints on their faces or vertical edges. All such welds shall be ground, filled and dressed smooth to make them invisible and provide a smooth flush surface. All window assemblies shall be rigid and neat in appearance, free from warp, age or buckle. Corner bends shall be true and straight, and of minimum radius for the gauge of metal used. Window faces shall be jointed at their vertical edges by a continuous weld extending the full height of the window. All such welds shall be ground, filled (mastiqued) and dressed smooth to make them invisible and provide a smooth flush surface. All steel window assemblies shall be thoroughly cleaned to remove all dirt and rust and chemically treated to insure maximum paint adhesion. All surfaces of the window assembly exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on, suitable as a base for finish paints.

F. Unless steel window assemblies are factory finish painted, two compatible coats of finish paint shall be applied in the field. The finish paint shall be of a type recommended for use on primed steel.

G. Casement Window Hardware:

1. Basis of Design Manufacturer: Subject to compliance with requirements, provide products by Truth Hardware or by one of the following:

    a. Architect approved equal.

2. Window Hardware Components:

    a. Operators: Maxim single arm assembly, sill mount #52.01.
    b. Casement Hinges: Standard duty, concealed, non-magnetic stainless steel track, heavy gauge steel and stainless steel reinforcing.

        1) Finish: Manufacturers corrosion resistant coating.
        2) Handing: See Drawings.
        3) Screws: Types of corrosion resistant screws required determined by material of profile being used.
        4) Provide all components per manufacturer recommendations for a complete hinge operating assembly.

    c. Operator Locking Handles:

        1) Locking System Assembly: Rear mounted #24.25. High pressure zinc die-cast locking handle and housing. Stainless steel strike. Aluminum tie bar.

            a) Finish: Manufacturers corrosion resistant coating. Color as selected by Architect from standard color range.

        2) Concealed Snubbers: Made of corrosion resistant materials.
        3) Screws: Types of corrosion resistant screws required determined by material of profile being used.
        4) Provide all components per manufacturer recommendations for a complete locking operating assembly.

H. Weatherstripping: On all units, including Transoms.

1. Frame: Unless indicated otherwise, full perimeter Black bulb EPDM.
2. Sash: Unless indicated otherwise, perimeter EPDM dust fin.

2.20 METAL GRATINGS

A. Custom Fabricated Gratings:

1. Fabricate gratings to dimensions as shown on drawings using 3 mm x 25 mm steel flat bar welded in grid pattern grate with 19 mm x 19 mm openings.
2. Fabricate continuous rectangular frame for grate using 31 mm x 31 mm steel angle.
3. Cast concrete lip so that grate sits flush with finish surface.

2.21 BLADE SPIKES

A. Wall Spike System:

1. Material: Iron.
2. Finish: hot-dipped galvanized and electro galvanized
3. Spike Thickness: 0.8mm-3mm.
4. Head Diameter: 0.8 - 1.0m.
5. Length: Minimum 2.0 m.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 75 mm above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING NOSINGS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

3.5 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 0.05-mm dry film thickness.

END OF SECTION 055000

SECTION 055010 – METAL SUPPORT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results Includes:

1. Steel slotted channel support systems for all ceiling mounted equipment including but not limited to:

a. Surgical Light Supports.
b. Procedure/Exam Light Supports.
c. Gas/Service Column/Boom Supports.
d. Radiographic Equipment.
e. Monitor Equipment.
f. Scan Equipment.
g. Single Point Monitor or Projector Supports.
h. TV Supports.
i. Operable Partitions Overhead Supports.
j. Hose Reels Supports.

1.3 PERFORMANCE REQUIREMENTS

A. Materials should conform to the appropriate specifications from ASTM, AISI, AISC, and / or AWS.

B. Any layouts indicated in the Drawings are for concept only and should not be taken as final designs nor shall be used for material take-off nor used for estimating purposes in any way.

C. The building structural members, elevations, and room layout shall be fully coordinated for the design of all supports. Equipment loads must be adequately supported from the building structural members and distributed accordingly. Floor to floor distances, finished ceiling elevations, room locations, and building support structure elevations must all be coordinated for appropriate design of support systems for proper understanding of required hanger lengths, bracing requirements, attachment design, etc.

D. Loads to be used shall be per each equipment manufacturer’s specification.

E. An overall system minimum factor of safety of two (2) shall be used for strength design.

F. Minimum rotational requirements, unless otherwise stated in the equipment manufacturer’s specifications, shall be as follows:

1. For all light and gas/service column/booms: Maximum rotation on the equipment mounting plate shall be no greater than 0.20 degrees per 304 mm.
2. For all Unistrut Ceiling Channel Grids and Ceiling Channel Systems: Maximum deflection on the system shall be no greater than 1.58 mm for any one location of worst case loading on the system.

G. All systems shall be adequately braced in all four directions for lateral loading. If no lateral loading is specified by the equipment manufacturer's specifications, 1/10th of the static downward loading shall be applied in the horizontal axis. Movement shall not exceed the total for that allowed on the system at the worst case loading condition.

H. For ceiling channel, rails shall be designed for no more than 1/720th of the span maximum deflection in either plane when maximum loading conditions are applied due to equipment operation.

I. Ceiling channel shall be installed horizontal in plane and parallel to each other within 1/32nd of an inch.

J. Anchorage to the structure shall be as designed by the structural engineer of the system.

1. Mechanical anchors into concrete shall be designed with a minimum factor of safety of 6 and shall be either expansion bolts, epoxy anchors, or through bolts with backing plate.
2. Anchorages into concrete where occurs shall not penetrate reinforcing bars.
3. Connections to structural steel shall be clamp-on fittings or field welding.
4. Drilling through truss bottom chords shall not be allowed.

1.4 SUBMITTALS

A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Employ a qualified and competent structural engineer to directly supervise all design and construction / installation phases.

1. Shop Drawings: Show fabrication and installation details for support system.

a. Include plans, elevations, sections, and details of support system and their connections. Show anchorage and accessory items.
b. Provide complete coordination with the equipment suppliers to verify all loading and installation requirements and shall be responsible for directly contacting these companies for the latest design requirements.
c. Manufacturer's installation instructions for each equipment being supported.

B. Calculations: Structural calculations for all member and connections shall be submitted. The metal support system shall lend itself to a rational structural analysis with section properties of framing members demonstrated by calculations. Calculations must include design for deflection and rotational requirements, as applicable, and not just stress. Structural calculations and drawings shall be furnished with a stamp by a licensed engineer in the state where the installation is to occur complying with all applicable building codes and regulatory requirements.

1.5 QUALITY ASSURANCE

A. Material and installation shall be provided by qualified and competent persons from a Design-Build Medical Equipment Support Contractor with at least ten (10) years experienced in the

professional engineering, design, manufacture and installation of adjustable metal framing supports of similar scope and size and shall maintain a continuing quality assurance program for both its material and installation crews.

B. Provide single source responsibility, coordination and liability for all engineering, design, materials and workmanship, and shall provide as single limited warranty for all aspects of the project: engineering, fabrication, material quality, and installation. Installing contractor must be a trained representative of the cold formed metal framing system manufacturer.

C. Pre-Installation Meeting: Conduct a pre-installation meeting a minimum of two weeks before start of installation of support systems. Require attendance of parties directly affecting work of this section, including Architect, Owner representative, sub-contractors, equipment representative(s). Review the following, but not limited to:

1. Approved Shop Drawings.
2. Sequencing.
3. Mechanical, Plumbing, and Electrical installation coordination.
4. Time restrictions.
5. Access to areas.
6. Finished Ceiling Elevations.
7. Reflected Ceiling Plan light fixture locations.
8. Final equipment center-point / iso-center locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide products by Unistrut Corporation or Architect approved equal.

2.2 MATERIALS

A. Channel: All cold-formed channel members shall be fabricated from structural grade steel conforming to one of the following ASTM specifications: A1011 SS GR 33 or A653 GR 33. Channel shall be 25 mm framing system 12 Gage. Minimum yield strength shall be 33 ksi.

B. Fittings: All cold-formed fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A575, A576, A36, or A653. Minimum fitting thickness shall be 6 mm with physical requirements per A1011. Minimum yield strength shall be 33 ksi.

C. Channel Nuts: All channel nuts shall be fabricated from steel conforming to ASTM specification A1011 SS GR 33.

D. Bolts and Fasteners: All bolts and fasteners used in connections shall be minimum SAE Grade 5, EG finish. Threaded Rod Grade B7.

E. Hot Rolled Structural Steel: ASTM A36 minimum.

2.3 FINISHES

A. All cold-formed channel and/or fitting members shall be finished in accordance with one of the following standards:

1. Perma-Green II: Rust inhibitive acrylic enamel paint finish applied by electro-deposition, after cleaning and phosphating, and thoroughly baked. Color per Federal Standard 595a color number 14109 (dark limit V-). Finish paint shall withstand minimum 400 hours salt spray (scribed), and 600 hours salt spray (unscribed), when tested in accordance with ASTM B117. Or Architect approved equal paint finish.
2. Electro-Galvanized: Electrolytically zinc coated per ASTM B633 Type III SC 1.
3. Pre-Galvanized: Zinc coated by hot-dipped process prior to roll forming. The zinc weight shall be G90 conforming to ASTM A653.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Fit exposed connections accurately together to form hairline joints.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where support system are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 CLEANING AND PROTECTION

A. Upon completion, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

B. Protect work from damage until substantial completion.

END OF SECTION 055010

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
2. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
3. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
4. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

C. Samples: For each type of exposed finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. Southern African Institute of Welding (SAIW).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

1. Handrails and Top Rails of Guards:

a. Uniform load of 0.73 kN/m applied in any direction.
b. Concentrated load of 0.89 kN applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 0.22 kN applied horizontally on an area of 0.093 sq. m.
b. Infill load and other loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 67 deg C, ambient; 100 deg C, material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 38 mm clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Tubing: ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4 FASTENERS

A. General:

1. Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

E. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

K. Form Changes in Direction by bending.

L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 6 mm or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide steel sleeves not less than 150 mm long with inside dimensions not less than 13 mm greater than outside dimensions of post, with metal plate forming bottom closure.

R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Galvanized steel pipe meeting requirements of ASTM A 53 or galvanized steel tubing meeting requirements of ASTM A 501. Provide galvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 2 mm in 1 m.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 6 mm in 3.5 m.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Three (3) Coats, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 50 mm beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 150 mm of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 125 mm deep and 20 mm larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions options:

    a. use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.
    b. use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
    c. use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

1. Wood blocking, shims, grounds and nailers.
2. Plywood backing panels.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and are not exposed, unless otherwise indicated.

B. Dimension Lumber: Lumber of 50 mm nominal or greater size but less than 127 mm nominal size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

A. Lumber shall be certified and tested per the following:

1. South African Technical Auditing Services (SATAS), according to the International Standards organization (ISO) Guide 65.

B. Source Limitations for Fire-Retardant-Treated Wood: Where required, obtain each type of fire-retardant-treated wood product through one source from a single producer.

C. See Structural Drawings for any wood blocking requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Factory mark each piece of lumber with grade stamp of grading agency.

B. Where nominal sizes are indicated, provide actual sizes required for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

C. Provide dressed lumber that has been surfaced on both faces and received a rip on both edges, resulting in a board with two flat and parallel faces and two flat and parallel edges, unless otherwise indicated.

D. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 50 mm nominal thickness or less, unless otherwise indicated.

2.2 TERMITE PROOFING

A. General:

1. All wood used in the permanent structure shall be made termite-resistant in all approved manner.
2. Millwork, and other shop fabricated items shall be termite-proofed by the manufacturer before transporting.

    a. Provisions of this section shall apply.
    b. Submit for approval proposed method of termite-proofing all millwork and carpentry items. Material used for termite-proofing shall not produce appreciable staining or discoloration; be compatible with finishes specified for millwork items. Door plywood faces having sealer or undercoat containing sufficient admixture of pentachlorophenol or other approved material may be submitted for approval, if sufficient penetration can be obtained by brush application. Stiles and other solid wood members will generally require 24-hour soaking in approved solution or equivalent treatment.

3. Spray unpaved areas prior to and after spreading of topsoil, to inhibit the habitation of termites and ants.
4. Spray sub-grade and fill materials in layers, under concrete floor slabs and pavements as protection against termites, ants, and other sub-terranean insects

B. Materials:

C. The compounds to be used on wooden elements for termite proofing shall be “carebelinium”, or “pentachlorophenol”, or “creosote”, or “woodtox”, as most appropriate for position use, or approved equal. No substitute shall be used without written approval. Where wood surfaces are to be painted, the termite-proofing compound shall be non-staining so as to leave the wood clean and paintable.

D. Selection of the proposed compound shall take into account the wet, humid climate conditions prevailing.

E. The compounds to be used on soil for termite and ant proofing on paved, unpaved, and building areas shall be “Sumicombi 30 EC”, “Nuvan 1000 EC”, and “Carbarly”, mixed in the required proportions and solvent, as appropriate for use, or approved equal.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process:

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency.

D. Application: Treat items indicated on Drawings and the following where occurs:

1. Wood nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood members that are less than 457 mm above the ground or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in identifying fire-retardant wood with appropriate classification marking of UL Testing or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Interior Type A High Temperature (HT), unless otherwise indicated.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.

B. For items of dimension lumber size, provide Construction grade lumber with 19 percent maximum moisture content of any species.

1. Local tropical red wood species.

C. For boards, provide lumber with 19 percent maximum moisture content and the following species and grades:

1. Local tropical red wood species.

2.6 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: Exterior grade sanded, fire-retardant treated, in thickness indicated or, if not indicated, not less than 19 mm nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NESNER-272.

D. Screws for Fastening to Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

E. Lag Bolts: ASME B 18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; wish ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn5

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set miscellaneous rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NESNER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

D. Use common wire nails or screws, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

E. Provide fire blocking in accordance with applicable code.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Coordinated with Structural Drawings for any wood blocking requirements.

D. Coping Blocking: Where occur, install blocking with anchor bolts embedded in or secured to substrate to resist wind uplift loads.

1. Spacing Within 2438 mm of Building Corners: 609 mm on center, maximum.
2. Spacing at Other Locations: 1219 mm on center, maximum.
3. Anchor Bolts: 12 mm diameter, staggered.

3.3 TERMITE PROOFING INSTALLATION

A. Apply termite-proofing compounds in accordance with manufacturer’s recommendations and instructions, or as directed, before fixing item.

B. Treat all lumber as far as practical and compatible with finish in a closed cylinder by a vacuum pressure system.

C. Retention of preservation: In accordance with manufacturer's instructions, but normally from 96 to 128 kgs. of preservation per cubic meter of lumber treated, 4.5 to 5.5 kgs. in contact with the ground. Due account shall be taken as to the type of preservative used in relation to the climatic conditions, and position where timber is to be used, the final amount of preservative retention being approved.

D. Apply two (2) brush coats to ends, and elsewhere, of all treated lumber cuts for framing and fitting in places.

E. Air season treated timber in contact with the ground after treatment for a period not less than 30 days.

F. Air season or kiln dry treated timber to be painted or varnished after treatment to a moisture content not in excess of 20% before painting with primer or sealer. No variation in this figure allowed.

G. Spraying on foundation, paved and unpaved areas: The chemicals shall be sprayed manually from mechanized compressed tanks, with the nozzle suspended approximately 150 mm from ground level. In the case of loose soil, soil will be compacted at 150 mm per coat sprayed. During application, spraying shall be done on paths at intervals of roughly 3 minutes.

END OF SECTION 061053

SECTION 062000 - BAMBOO POLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Bamboo poles for exterior use.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Indicate materials, component profiles, fastening methods, jointing details, and accessories.

C. Samples: Submit two each, 203 mm samples showing joints and range of color.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect work from damage.

PART 2 - PRODUCTS

2.1 BAMBOO POLES

A. Manufacturers: Subject to compliance with project requirements provide products:

1. Local sustainably harvested bamboo product.
2. Architect approved equal.

B. Decorative bamboo poles with wall thickness between 60 to 99 percent, lightly sanded with a polyurethane finish.

1. Size: Diameter and length as indicated on Drawings.
2. Color: Natural coloring between shades of tan and honey.
3. Usage: Exterior.

C. Termite Protection: Provide non-chemical methods of preservation with smoking method.

2.2 ACCESSORIES

A. Fasteners: Of size and type to suit application as recommended by manufacturer.

B. Galvanized Steel Wire: Of size and type to suit application as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify adequacy of support framing and attachment.

3.2 INSTALLATION

A. Pre-drill holes in the nodes (thickest part of the bamboo poles) and screw it onto the substrate indicated or attach with pneumatic nail gun. Hide screws from view using wood putty mixed with bamboo saw dust.

END OF SECTION 062000

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood cabinets.
2. Closet and utility shelving.
3. Shop finishing of interior woodwork.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Verification:

1. Lumber and panel products with shop-applied opaque finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels, for each finish system and color, with[1/2 of exposed surface finished.
2. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:

B. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

2.2 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species for Opaque Finish: Any closed-grain hardwood.

C. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

D. Float Glass for Cabinet Doors: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3, 6.0 mm thick.

E. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick, unless otherwise indicated.

2.3 CABINET HARDWARE AND ACCESSORIES

A. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.

D. Catches: Magnetic catches, BHMA A156.9, B03141.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Adhesives shall not contain urea formaldehyde.

D. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Contact Adhesive: 250 g/L.

2.5 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom -grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated.

D. Complete fabrication, including assembly, finishing and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for

shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

F. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.6 WOOD CABINETS FOR OPAQUE FINISH

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.

D. Panel Product for Exposed Surfaces: Medium-density fiberboard.

E. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Match materials indicated for exposed surfaces.
2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.7 CLOSET AND UTILITY SHELVING

A. Grade: Custom.

B. Shelf Material: 3/4-inch (19-mm) .

C. Wood Species: Rubberwood

2.8 SHOP FINISHING

A. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Shop Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing architectural woodwork not indicated to be shop finished.

C. Opaque Finish:

1. Color: As selected by Architect from manufacturer's full range.
2. Sheen: As selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish or toggle bolts through metal backing or metal framing behind wall finish.

G. Countertops: Refer to Division 12 for Countertop work.

H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 071000 - DAMPPROOFING AND WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.3 SUMMARY

A. Section Includes:

1. Sheet Membrane Waterproofing.
2. Under-Slab-On-Grade Vapor Retarder.

1.4 SYSTEM DESCRIPTION

A. General: Provide waterproofing that prevents the passage of liquid water under hydrostatic pressure and complies with requirements as demonstrated by testing performed by an independent testing agency of manufacturer's current sheet membrane.

1.5 SUBMITTALS

A. Include product data on each type of dampproofing and waterproofing product specified, including data substantiating that materials comply with specified requirements.

1. Mark each copy to identify applicable products, characteristics, models, options and other supplemental data to clearly communicate information specific to this project.

B. Samples, 3 by 6 inches minimum size, of each fluid-applied and sheet membrane waterproofing material specified for Project.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed fluid-applied and sheet membrane waterproofing applications similar in material, design, and extent to that indicated for Project and that has resulted in construction with a record of successful in-service performance.

1. Assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, and flashings used in conjunction with waterproofing, expansion joints in membrane, insulation, and protection course on membrane, to Installer of fluid-applied waterproofing, for single, undivided responsibility.

B. Single-Source Responsibility: Obtain primary waterproofing materials of each type required from a single manufacturer.

C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer'' name, product, date of manufacturer, and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Conditions: Apply waterproofing within range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in rain, fog, or mist.

B. Maintain adequate ventilation during penetration and application of waterproofing materials.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. General Compatibility: Provide products that are recommended by manufacturer to be fully compatible with indicated substrates.

2.2 SHEET MEMBRANE WATERPROOFING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. GCP Applied Technologies; Bituthene 4000.
2. Carlisle Coatings and Waterproofing Inc.; CCW MiraDRI 860/861.
3. Polyguard Products Inc.; 650 Waterproofing Membrane.
4. Architect approved equal.

B. Modified Bituminous Sheet: Minimum 1.5-mm nominal thickness, self-adhering sheet consisting of 1.4 mm of rubberized asphalt laminated on one side to a 0.10-mm thick, high density polyethylene-film reinforcement. Provide rubberized asphalt membrane covered with a release sheet which is removed during installation. No special adhesive or heat shall be required to form laps.

1. Tensile Strength, Membrane Die C: 2240 kPa (325 lbs/in.^{2}) minimum.
2. Elongation, Ultimate Failure of Rubberized Asphalt: 300% minimum.
3. Puncture Resistance, Membrane: 222 N (50 lbs) minimum.

C. Waterstop: Hydrophilic non-bentonite waterstop for non-moving concrete construction joints.

2.3 UNDER-SLAB-ON-GRADE VAPOR BARRIER:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Stego Industries, LLC.;Stego Wrap (15 mil) Vapor Barrier.
2. W.R. Meadows, Inc.; Perminator (15 mil) Underslab Vapor Retarder.
3. Griffiolyn a Division of Reef Industries; Griffoyln (15 mil).
4. Raven Engineered Films Division, Raven Industries; VaporBlock 15.
5. Architect approved equal.

B. Vapor Barrier Under-Slabs-On-Grade:

1. Plastic Vapor Retarder: ASTM E 1745, Class A, with maximum performance rating of 0.018 perm. Provide in lengths and widths required for least number of seams.
2. Vapor- Barrier Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.4 MISCELLANEOUS MATERIALS

A. Surface conditioner, primers, fillers, flashings, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

B. Protection Course: Board as approved by system manufacturer, premolded, 3 mm thick, semirigid board consisting of mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, surface-coated with asphalt and sealed to core under heat and pressure, and provided with polyethylene film facings complying with ASTM D 6506.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which waterproofing systems will be applied, with Installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

1. Do not proceed with installation until after minimum concrete curing period recommended by waterproofing manufacturer.
2. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Inspect concrete and concrete masonry surfaces for:

1. Contamination: Algae, chalkiness, dirt, dust, efflorescence, form oil, fungus, grease, mildew or other foreign substances.
2. Surface absorption and chalkiness.
3. Cracks: Measure crack width and record location of cracks.
4. Damage and deterioration.
5. Moisture content and moisture damage:

a. Use a moisture meter to determine if the surface is dry enough to receive the air and moisture barrier and record any areas of moisture damage or excess moisture.

6. Compliance with specification tolerances:

a. Record areas that are out of tolerance (greater than 1/4 inch in 8-0 feet deviation in plane).

7. Notify Architect in writing of anticipated problems using waterproofing over substrate.

3.2 PREPARATION

A. Clean substrate of projections and substances detrimental to work; comply with instructions of prime materials manufacturer.

B. Install can't strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.

C. Fill voids, seal joints, and apply bond breakers as recommended by prime materials manufacturer.

D. Prime substrate as recommended by prime materials manufacturer.

3.3 INSTALLATION - GENERAL

A. Comply with manufacturer's written installation recommendations, including preparation of substrate surfaces, detail coatings of joints and planar changes in substrate, and priming of substrates.

B. Mix separately packaged components in accordance with manufacturer's written recommendations.

3.4 INSTALLATION - SHEET MEMBRANE WATERPROOFING

A. Apply waterproofing membrane material to substrates and adjoining surfaces indicated to receive membrane. Apply in accordance with manufacturer's recommendations to obtain thicknesses specified and using applicators and techniques best suited for slope and type of substrate to which applied.

1. If two-coat application is required to obtain membrane thickness specified below, apply second coat only after initial coat has cured as recommended by manufacturer.
2. Provide 60 mil (average) membrane thickness, with minimum 50 mil thickness.

B. Install sheet membrane waterproofing material to substrates and adjoining surfaces indicated to receive membrane. Install in accordance with manufacturer's recommendations using applicators and techniques best suited for type of substrate to which applied.

C. Install sheet-type flashings and joint covers were indicated and as recommended by prime materials manufacturer. Extend flashings onto perpendicular surfaces and other work penetrating substrate to not less than 6 inches beyond finished surface to be applied over waterproofing.

D. Permit membrane to cure under conditions that will not contaminate or deteriorate waterproofing material. Block off traffic and protect membrane from physical damage.

E. Install protection course on cured membrane (after testing, if required) without delay to minimize period of membrane exposure.

1. On vertical surfaces comply with waterproofing manufacturer's recommendations for adhesion of protection course to membrane.
2. In-Place Testing: Before completed membranes on horizontal surfaces are covered by protection course or other work, test for leaks with 2-inch depth of water maintained for 24 hours. Repair any leaks revealed by examination of substructure and repeat test until no leakage is observed.

F. Provide separation between waterproofing membrane and non-compatible substrates and materials in accordance with manufacturers published instructions.

3.5 INSTALLATION - UNDER-SLAB-ON-GRADE VAPOR RETARDER

A. General: Extend vapor and moisture barriers to extremities of areas to be protected from vapor transmission. Extend vapor and moisture barriers to cover miscellaneous voids in insulated substrates, including those which have been stuffed with loose fiber-type insulation.

B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape of type recommended by vapor retarder manufacturer to create an air-tight seal between penetrating objects and vapor retarder.

C. Repair any tears or punctures in vapor and moisture barriers immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.6 PROTECTING AND CLEANING

A. Protect waterproofing from damage and wear during application and remainder of construction period, according to manufacturer’s written instructions.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071000

SECTION 072100 - THERMAL INSULATION

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Glass-fiber blanket.
3. Radiation barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Owens Corning.
2. Dow Chemical Company.
3. CertainTeed Corporation.
4. Johns Manville; a Berkshire Hathaway company.
5. Architect approved equal.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded Polystyrene Board: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

2.3 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Plate: Perforated, galvanized carbon-steel sheet, 0.76 mm thick by 50 mm square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 2.66 mm in diameter; length to suit depth of insulation.

B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.6 RADIANT BARRIERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fi-Foil Company.
2. Innovative Energy, Inc.
3. Innovative Insulation, Inc.
4. Insulation Solutions, Inc.

5. Reflectix Inc.
6. TVM Building Products.
7. Architect approved equal.

B. Description:

1. Sheet Radiant Barrier: ASTM C 1313/C 1313M with at least one surface with emittance value of 0.1 or less as measured per ASTM C 1371.
2. Multi-laminate, perforated, sheet radiant barrier.
3. Two outer layers of aluminum foil laminated to layer of woven polyethylene.
4. Thickness of Each Layer: Minimum 0.00635 mm.

C. Testing:

1. Corrosivity, ASTM D 3310: Pass.
2. Mold and Mildew Resistance, ASTM C 1338: Does not promote growth.
3. Foil Emittance, ASTM C 1371: 0.03 to 0.04.
4. Reflectivity: 0.96 to 0.97.
5. Tear Resistance, ASTM D2261.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

E. Butt panels together for tight fit.

F. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.

2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over to compress insulation.
4. Where installation will not be covered by other building materials, apply capped washers to tips of spindles.

G. Adhesive Installation: Install with adhesive or press into tacky waterproofing or damp-proofing according to manufacturer's written instructions.

H. Blanket Installation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 76 mm clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

I. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 40 kg/cu m.

J. Install sheet radiant barriers according to ASTM C 1744.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 076100 - SHEET METAL ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preformed, prefinished metal roof panels with exposed-fastener, lap-seam.
2. Fastening devices and accessories.

B. DESIGN / PERFORMANCE REQUIREMENTS

C. Design Requirements for Roof Systems:

1. System Design: Metal roof system as designed by the manufacturer shall be a complete system. All components of the system shall be supplied by the same manufacturer.
2. Roof Panels: Steel panels shall be designed in accordance with the AISI (American Iron and Steel Institute) Cold-Formed Steel Design Manual.
3. Design Loads: Design load application shall be in accordance with the International Building Code (IBC) and as indicated on Structural Drawings.
4. Wind Loads: The design wind loads shall be based on the wind criteria in accordance with the International Building Code (IBC) and as indicated on Structural Drawings.
5. Deflection: Deflection requirements shall be in accordance with the applicable building code, or as a minimum, L/180 for wind load (but not less than 49 kg/sq m.
6. Thermal Expansion and Contraction: Completed metal roofing and flashing system shall be capable of withstanding expansion and contraction of components caused by changes in temperature without buckling, producing excess stress on structure, anchors or fasteners, or reducing performance ability. Design temperature differential shall be not less then 200 degrees F.
7. Accessories and Fasteners: Accessories and fasteners shall be capable of resisting the specified design wind suction forces in accordance with the International Building Code (IBC).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer product data, general recommendations and installation instructions on product being used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations
3. Installation methods.

B. Shop Drawings: Elevations and plans showing layout of roof and wall panels, sections and details, fastening and joint details, trim, flashing, vents, openings, sealant and accessories. Show details of interfaces with adjacent products, weatherproofing, terminations, and penetrations of metal work.

C. Design Loads: Submit manufacturer's minimum design load calculations for Components and Cladding. In no case shall the design loads be taken to be less than those specified herein.

D. Verification Samples: For each finish product specified, two samples, minimum size 305 mm square, representing actual product, color, and texture.

E. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

F. Closeout Submittals:

1. Provide executed copy of manufacturer’s warranty as applicable.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels to job site properly packaged to provide protection against transportation damage.

B. Deliver materials in labeled packages. Protect from damage by weather, excessive temperature and construction operations during delivery, storage, and handling.

C. Stack all materials to prevent damage and to allow for adequate ventilation. Elevate one end to promote drainage.

D. Store products in unopened and undamaged packaging with label intact in a clean, dry indoor location until ready for installation.

E. Panels with strippable film must not be stored in the open, exposed to the sun.

F. Protect panels from contact with materials that could cause staining or discoloration of the finish.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Minimum Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

1.6 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Structural Drawings.
2. Other Design Loads: As indicated on Structural Drawings.
3. Deflection Limits: For wind loads, no greater than minimum 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.3 L/s per sq. m when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: Minimum 75 Pa.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: Minimum 137 Pa.

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 67 deg C, ambient; 100 deg C, material surfaces.

2.2 SHEET METAL ROOFING AND SIDING

A. General: Provide factory-formed metal roof panels designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Corrugated-Profile, Exposed-Fastener Metal Roof Panels: Formed with alternating curved ribs spaced at 178 mm o.c. across width of panel.

1. Basis of Design Manufacturer: Subject to compliance with requirements, provide products by Global Roofing Solutions; IBR 890 / Supa-Clad or comparable product by one of the following:

    a. Alcoa Architectural Products (USA).
    b. Firestone Metal Products, LLC.
    c. McElroy Metal, Inc.
    d. Architect approved equal.

2. Steel Sheet: Galvanized steel sheet complying with ASTM A 653/A 653M, SANS 4998, SANS 3575, EN 10346.

    a. Nominal Thickness: 0.58 mm thick 'or equal and approved.'
    b. Exterior Finish: Chromadek Ultim (special finish for marine environments).
    c. Color: As selected by Architect from manufacturer's full range.

3. Panel Description: The profile shall have six trapezoidal ribs at 178 mm centers giving a net cover of 890 mm with each pan incorporating one stiffener rib.
4. Panel Height: 37 mm.
5. Panel Length: Long span, size as recommended by manufacturer from Drawings.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Where required, provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Sheet Metal Accessories: Provide components required for a complete, weathertight panel system including trim, copings, cleats, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Use metal components fabricated from same gauge and finish as metal panels, unless otherwise noted.
2. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
4. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 125-mm thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Class 3 fasteners, complying with SANS 1273.

1. Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 13 mm wide and 3 mm thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations, Drawings and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by metal panel manufacturer for application, but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify primary and secondary framing members are installed and fastened, properly aligned and sloped where required.

B. Verify openings, pipes, sleeves, ducts, or vents through panels are solidly set, properly frame and located.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation

B. Prepare surfaces using the methods recommended by the manufacturer

3.3 INSTALLATION

A. Install roofing in accordance with approved shop drawings and manufacturer’s instructions.

B. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air or water-resistive barriers and flashings that are concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

C. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.
6. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 152 mm end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

1. Flashing: 0.58 mm thick galvanized Z275 steel with Chromadek Ultim finish.
2. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
3. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m with no joints allowed within 610 mm of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with mastic sealant (concealed within joints).

H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 6 mm in 6 m on slope and location lines and within 3 mm offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal panel installation, including accessories. Report results in writing.

B. Remove and replace applications where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed panels until project’s Substantial completion.

B. Remove, replace or touch-up damaged panels before project’s Substantial completion.

END OF SECTION 076100

SECTION 076200 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included:

1. Aluminum flashings and counterflashings.
2. Gutters and downspouts.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing capable of resisting the following forces per recommendations in FMG Loss Prevention Data Sheet 1-49.

1. Wind Zone: As indicated or per Code requirements.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hold elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoin work.
4. Details of expansion joint covers, including showing direction of expansion and contraction.

C. Samples for Verification: For each type of exposed finish required, prepare a sample of size indicated below:

1. Sheet Metal Flashing: 304 mm long, roof edge flashings, roof edge drainage systems, counterflashings, include fasteners, cover joints, cleats, clips, closures, and other attachments.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of roof edge flashings with performance requirements.

1.5 QUALITY INSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Mockups: Build mockups in dimensions and locations directed by the Architect to demonstrate aesthetic effect and set quality standards for fabrication and installation.

1. Approval of mockups is for other material and construction qualities specifically approved by Architect in writing.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Aluminum-Zinc Alloy Steel Sheet: ASTM A 653/A 653M, Thickness as specified in this Section.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with elastomeric sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.4 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Fabricate section lengths not exceeding 3 m, with matching corner units, ends, outlet tubs, and other accessories. Elevate back edge at least 25 mm above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Fabricate from the following exposed metal:

a. Galvanized steel sheet (0.58mm), Chromadek Ultim finish. Provide color samples for architect approval.

2. Gutter Profile: As indicated according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and soldered.
4. Gutter Supports: As indicated with finish matching the gutters.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
1. Hanger Style: Strap type.

a. Galvanized steel sheet (0.58mm), Chromadek Ultim finish. Provide color samples for architect approval.

C. Splash Pads: Precast concrete.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Fabricate from the following materials:

1. Galvanized steel sheet (0.58mm)

B. Counterflashing: Fabricate from the following materials:

1. Galvanized steel sheet (0.58mm)

C. Flashing Receivers: Fabricate from the following materials:

1. Galvanized steel sheet (0.58mm), C

D. Roof-Penetration Flashing: Fabricate from the following materials:

1. Galvanized steel sheet (0.58mm)

DI. Roof-Drain Flashing: Fabricate from the following materials:

1. Galvanized steel sheet (0.58mm)

2.6 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 2 m long, but not exceeding 3 m, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 152 mm beyond each side of wall openings; and form with 50 mm high, end dams. Fabricate from the following materials:

1. Galvanized steel sheet (0.58mm)

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet or install a course of polyethylene underlayment.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 304 mm apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m with no joints allowed within 609 mm of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used, or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 31 mm for nails and not less than 19 mm for wood screws.

1. Aluminum: Use aluminum or stainless steel fasteners.
2. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 25 mm into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 4 and 21 deg C, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 4 deg C.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section “Joint Sealants.”

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 38 mm except where pretinned surface would show in finished Work.

1. Do not solder aluminum sheet.
2. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

C. Fasten gutter spacers to front and back of gutter.

D. Anchor and loosely lock back edge of gutter to continuous cleat eave or apron flashing.

E. Anchor gutter with gutter brackets spaced not more than 609 mm apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.

F. Install gutter with expansion joints at locations indicated, but not exceeding, 15 m apart. Install expansion-joint caps.

G. Downspouts: Join sections with 38 mm telescoping joints.

H. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 1524 mm o.c.

I. Provide elbows at base of downspout to direct water away from building.

J. Splash Pans: Install where downspouts discharge.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof Hatches.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.

1.4 QUALITY ASSURANCE

A. Standards: Comply with the following:

1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by Bilco Company; Type F Roof Hatch or Architect approved equal.

2.2 ROOF HATCHES

A. General: Fabricate units to withstand 40-lbf/sq. ft. external and 20-lbf/sq. ft. internal loading pressure. Frame with minimum 12-inch-high, integral-curb, double-wall construction with 1--inch

insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints. Provide double-wall cover (lid) construction with 1- inch-thick insulation core. Provide gasketing and equip with corrosion-resistant or hot-dip galvanized hardware including pintle hinges, hold-open devices, interior padlock hasps, and both interior and exterior latch handles.

B. Material: Aluminum, sheets and extrusions.

C. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.

D. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch- diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.
6. Color: As indicated by manufacturer's designations.

2.3 MATERIALS, GENERAL

A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

C. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.

D. Wood Nailers: Softwood lumber, not less than 1-1/2 inches thick, complying with the requirements of Division 06 Section, Rough Carpentry.

E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

G. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.

H. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

I. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

J. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of framing, roof deck, blocking, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated,

C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

F. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 077200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:

a. Construction joints in cast-in-place concrete.
b. Control and expansion joints in unit masonry.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
e. Control and expansion joints in ceilings and other overhead surfaces.
f. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Joints between different materials listed above.
c. Other joints as indicated.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Tile expansion, contraction and isolation joints.
d. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
g. Joints between counters, backsplashes, and adjoining walls.
h. Joints between different materials, unless directed otherwise.
i. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:

a. Isolation joints in cast-in-place concrete slabs.
b. Expansion, contraction and isolation joints in tile flooring.
c. Joints between different materials, unless directed otherwise.
d. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

F. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturers standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Submit not fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if joint sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates as follows:

1. Locate test joints where indicated or, if not indicated, as directed by Architect.
2. Conduct field tests for each type of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants by hand-pull method described below:

    a. Install joint sealants in 60-inch-long joints using same materials and methods for joint preparation and joint-sealant installation required for the completed Work. Allow sealants to cure fully before testing.
    b. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.
    c. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
    d. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

6. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 PRODUCT HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Mechanical damage caused by individuals, tools, or other outside agents.

D. Provide material warranties for each type of sealant as follows:

1. Latex Sealants: 5 year material warranty.
2. Urethane Sealants: 10 year material warranty.
3. Silicone Sealants: 15 year material warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of this Section.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range, unless otherwise indicated.

1. For joints in exterior assemblies, provide custom colors to match Architect's samples.

C. VOC Content of Interior Sealants:

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

D. Stain Test: ASTM C 1248.

2.3 ELASTOMERIC JOINT SEALANTS -GENERAL

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of this Section, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

2.4 LATEX JOINT SEALANTS - GENERAL

A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of this Section.

2.5 SILICONE JOINT SEALANTS

A. Single-Component, Neutral-Curing Silicone Sealant:

1. Products: Provide one of the following:

a. GE Silicones; SilPruf SCS2000 or LM SCS2700.
b. Pecora Corporation; 864.
c. Polymeric Systems Inc.; PSI-641.
d. Sonneborn, Division of ChemRex Inc.; Omniseal.
e. Tremco; Spectrem 3.
f. Architect approved equal.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50

4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Exterior non-traffic building joints in metal trim, metal panels, metal roof drainage systems, and metal in glazing assemblies.

B. Mildew-Resistant Silicone Sealant:

1. Products: Provide one of the following:

    a. Dow Corning; 786 Mildew Resistant.
    b. GE Silicones; Sanitary SCS1700.
    c. NUCO Industries, Inc.; NuFlex 302.
    d. Pecora Corporation; 898.
    e. Tremco; Tremsil 600 White.
    f. Architect approved equal.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50
4. Formulation: Formulated with fungicide.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
7. Applications: Perimeter joints of plumbing fixtures, counters and backsplashes; and perimeter joints in ceramic tile.

C. Exterior Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Tremco Incorporated; Spectrem 2 as basis of design.
    b. BASF Building Systems; Omniseal 50.
    c. Dow Corning Corporation; 756 SMS.
    d. GE Construction Sealants – Momentive Performance Materials; SilGlaze II SCS2800.
    e. May National Associates, Inc.; Bondaflex Sil 295.
    f. Pecora Corporation; 864.
    g. Polymeric Systems, Inc.; PSI-641.
    h. Sika Corporation, Construction Products Division; SikaSil-C995.
    i. Architect approved equal.

2. Colors: As selected by Architect from manufacturer's full range; multiple colors may be required.
3. Applications:

    a. Control and soft joints in masonry.
    b. Weather seals between architectural precast concrete panels.
    c. Sealant joints in metal composite material and phenolic cladding.
    d. Joints between metal frames and other materials.
    e. Joints between dissimilar exterior materials.
    f. Other exterior non-traffic bearing joints for which no other sealant is indicated

2.6 URETHANE JOINT SEALANTS

A. Single-Component Nonsag Urethane Sealant:

1. Products: Provide one of the following:

a. Bostik Findley; Chem-Calk 915.
b. Pecora Corporation; Dynatrol I-XL.
c. Pecora Corporation; Flexiprene 1000.
d. Polymeric Systems Inc.; PSI-901.
e. Tremco; DyMonic.
f. Tremco; Vulkem 921.
g. Architect approved equal.

2. Class: 25.
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
5. Applications: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

B. Multicomponent Pourable Urethane Sealant:

1. Products: Provide one of the following:

a. Bostik Findley; Chem-Calk 550.
b. Meadows, W. R., Inc.; POURTHANE.
c. Pecora Corporation; Urexpan NR-200.
d. Tremco; THC-900.
e. Tremco; Vulkem 245.
f. Architect approved equal.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Exterior joints in horizontal traffic surfaces.

2.7 BUTYL-RUBBER-BASED JOINT SEALANTS

A. Exterior Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Tremco Incorporated; Tremco.
b. Bostik, Inc.; Chem-Calk 300.
c. Pecora Corporation; BC-158.
d. Architect approved equal.

2. Applications: Concealed sealant bead in sheet metal and flashing work.

a. Concealed sealant bead in sheet metal work.
b. Concealed sealant bead in metal wall panel overlaps.
c. Concealed sealant bead in vapor barrier.

d. Other concealed sealant joints where specified in other Sections.

2.8 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and

approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

B. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 079200

SECTION 079500 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results Includes:

1. Interior expansion control systems.
2. Exterior wall expansion control systems.

1.3 SUBMITTALS

A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

B. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches long in size.

C. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

2.2 COORDINATION

A. Coordinate installation of exterior wall control systems with roof systems to ensure wall transitions are watertight.

2.3 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.

B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.4 EXPANSION CONTROL SYSTEMS MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide by Construction Specialties, Inc indicated or a comparable product by one of the following:

1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
2. Balco, Inc.
3. JointMaster/InPro Corporation.
4. Michael Rizza Company, LLC.
5. MM Systems Corporation.
6. Nystrom, Inc.
7. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
8. Emseal Joint Systems Ltd.
9. Architect approved equal.

B. Color: As selected by Architect from manufacturer's full range.

C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

2.5 INTERIOR EXPANSION CONTROL SYSTEMS

A. Floor-to-Floor:

1. Basis-of-Design Product: DGTR-Series.
2. Type: Recessed.
3. Exposed Material: Aluminum/ Gasket.
4. Finish: Clear anodic, class II.
5. Seal: Manufacturer’s standard thermoplastic rubber (TPR) gaskets.
6. Fire Resistance: Equal to or greater than adjacent assemblies.
7. Joint Width: Minimum 1 inch (25 mm).
8. Attachment: Mechanical.
9. Load Capacity: Standard Duty.

B. Floor-to-Wall:

1. Basis-of-Design Product: GFTW-Series.
2. Type: Surface mounted, aluminum frame, elastomeric seal.
3. Exposed Material: Aluminum.
4. Finish: Clear anodic, class II.
5. Seal: Manufacturer's standard extruded thermoplastic rubber (TPR) gaskets.
6. Fire Resistance: Equal to or greater than adjacent assemblies.
7. Joint Width: Minimum 1 inch (25 mm).
8. Attachment: Mechanical.
9. Load Capacity: Standard Duty.
10. Seal Material: Santoprene or PVC as standard with manufacturer.

C. Masonry Wall-to-Wall In-plane and Corner Joints:

1. Basis-of-Design Product: FWF-Series.
2. Type: Thinline for interior masonry wall joints.

D. Gypsum Board Ceiling and Corner Joints:

1. Basis-of-Design product: FCS-Series and FCSC-Series.
2. Type: Metal frames and preformed seals for interior gypsum board ceiling corner joints.

2.6 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

A. Exterior Wall Expansion Joint:

1. Basis of Design Product: ASM-Series.
2. Type: Snap on cover.
3. Exposed Material: Aluminum.
4. Secondary Seal: Manufacturer's standard laminate reinforced polyethylene.
5. Finish: Clear anodic, class II.
6. Fire Resistance: Equal to or greater than adjacent assemblies.
7. Joint Width: 3 inches.

B. Exterior Walls Above Grade- Wall to Wall:

1. Acrylic-infused cellular polyurethane foam with factory-applied silicone face bellows.

    a. Basis of Design Product: Emseal, Seismic Colorseal.
    b. Color as selected by Architect from manufacturer's full range.

2.7 MATERIALS

A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.

D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.

E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

F. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

1. Color: As selected by Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion control system manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.

C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
5. Install frames in continuous contact with adjacent surfaces.

    a. Shimming is not permitted.

6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces and sides of slabs before installing compression seals.

E. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors from single manufacturer.

B. Test Certificates: Obtain from manufacturer.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCT

2.1 SOLID WOOD DOORS

A. Interior Solid-Core Doors:

1. Materials:

a. Fabricated from Hevea wood (“Rubberwood”) doors finger jointed minimum 38 mm thick. Panels clear hardwood lumber, selected by Architect for compatible grain and color.

2.2 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.

1. Wood Species:

a. Wood Veneer Faced Doors: Same species as door faces.

2. Profile: Manufacturer's standard shape.

2.3 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.4 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Custom.
2. Finish: AWI TR-6 catalyzed polyurethane system.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

PART 1 GENERAL DESCRIPTION

1.1

1.1.1 Scope

It is the intent that this section shall provide for the supply of all items of finishing hardware and adequately service this project as indicated in the Hardware Schedule and the drawings.

1.1.2 Work included

Supply of finishing hardware as scheduled including Hardware Schedule-Hardware Sets reviewing in conjunction to latest revision of Drawings and Specifications.

1.1.3 General requirements

1.1.3.1 Door hardware and furniture shall be approved types, suitable for the location and the intended function of the doors, in accordance with the Product Information and relevant Standards.

1.1.3.2 Submit Product Information, and Control Samples if directed.

1.1.3.3 Verify correct handing, internal external application, compliance to fire rating requirements, if applicable, and suitability of Hardware with the door type and door/frame construction, floor levels, door swing limits for all Hardware items before commencing.

1.1.3.4 Include fixings, striker plates, shims, and escutcheons for a complete installation, whether indicated or not.

1.1.3.5 Unless otherwise indicated, door hardware shall enable escape from the inside of the room or area contained by the door hardware.

1.1.3.6 Door furniture shall be suitable for use with the lock or latch to which it is installed. Include key-ways, key-hole plates, turn-buttons, cut-outs, roses, plates and escutcheons required by the lock or latch type, for a complete installation, whether indicated or not.

1.1.3.7 Unless the door furniture is indicated separately for each side of the door, supply furniture as a paired set for both side of the door. Furniture fixings on the outside face of doors shall be concealed by fixing through the door from inside or by other appropriate methods.

1.1.3.8 Unless otherwise indicated, door hardware shall be manufactured from cast, forged or machined brass with electroplated finish or stainless steel, including corrosion-resistant components, in accordance with the relevant standards.

1.1.4 Related trades

Coordinate the work of this trade with the base-structure, services and adjacent work.

Coordinate with:

STEEL DOORS AND FRAMES

WOOD DOORS

TEMPERED GLASS DOORS, SCREENS, PANELS AND BALUSTRADES

ALUMINUM FRAMED INTERIOR AND EXTERIOR GLAZED AND LOUVERED SCREENS, DOORS AND FRAMES.

CURTAINS WALL, EXTERIOR ENTRANCES

SLIDING DOORS

SIGNAGE

ELECTRICAL SERVICES for power and control wiring for electric, electro-magnetic and electronic strikes, locks, detectors, controllers and similar devices.

SECURITY SERVICES

1.1.5 Related documentation

Refer to:

DRAWINGS for locations and extent.

MATERIAL/PRODUCTS SCHEDULE for finishes selections.

DOOR SCHEDULE.

HARDWARE SCHEDULE

LIFE SAFETY STRATEGY

FIRE ENGINEERING REPORT for doors, if applicable.

ACOUSTIC REPORT for doors, if applicable.

1.2 REFERENCES

1.2.1 General

Comply with the current edition of all relevant standards to include:

No. of Doc.	*Title*
EN 1670	Corrosion resistance
EN 12209	Mechanically operated locks, latches and locking plates.
EN 1303	Cylinders for locks
EN 1935	Single axis hinges
EN 1154	Controlled door closing devices
EN 1155	Elec. Powered hold open devices for swing doors
EN 1158	Door coordinator devices
EN 1906	Lever handles and knob furniture
EN 1125	Panic exit devices operated by a horizontal bar
EN 1527	Hardware for sliding doors and folding doors
EN 12365	Gaskets and weather stripping
EN 1634	Fire Testing of door and shutter assemblies.

The BHIF (Builders Hardware Industry Federation) code of practice for hardware for timber fire and escape doors.

All hardware have to be tested and certified by UKAS approved testing laboratory or laboratories approved by the Local Ministry of Civil Defence.

All fire and life safety codes shall be met as required by the authority having jurisdiction(AHJ).

1.3 SUBMITTALS

1.3.1 Prepare and supply 6 copies of a completely detailed hardware schedule. The schedule will list all the doors by number, size, hand and degree of opening.

1.3.2 Indicate the handling of each door and the degree of swing. In case of pairs of doors, indicate the active door. Schedule to indicate the material, finish, dimensions, and details of fastenings for each hardware.

1.3.3 The schedule shall indicate the manufacturer's name and the article numbers.

1.3.4 Submit samples as each hardware type is specified finish and the appropriate fasteners.

1.3.5 Provide with templates and hardware schedule, original catalogue cuts of all the hardware scheduled.

1.3.6 Submit template information to the contractor for distribution to related trades.

1.3.7 Submit a key schedule for review with the consultant and the client.

1.3.8 Approved samples may be incorporated in the works unless otherwise instructed by the architect.

1.3.9 Submit affidavits to verify that hardware in each case has been installed in the correct location and that it is operating correctly.

1.4 QUALITY ASSURANCE

1.4.1 The supplier of finishing hardware shall be regularly involved in the sale and distribution of Builder's Hardware for commercial projects of this nature.

1.4.2 The supplier shall employ a qualified Architectural Hardware Consultant (A.H.C.) or Dip GAI (Guild of Architectural Ironmongers) to supervise all the issues related to doors and doors hardware. The Hardware consultant will be responsible for architectural submittals, samples submission, to review Hardware sets in conjunction with Drawings, specifications, statuary rules, international standards such as Life Safety code and Disability Act. The Hardware consultant should also look after material deliveries to site, making sure right material is delivered, marked and packed.

1.5 DELIVERY, STORAGE AND HANDLING

The supply shall ensure that deliver of proprietary packaged products in the manufacturer's original packages and containers with labels intact and legible, including installation instructions, templates and detailed delivery dockets. Packaging of hardware shall be (in):

Complete individual sets for each door.

Separate dust and moisture proof packages.

Clearly labelled to show intended locations.

Complete with required fixings.

1.6 WARRANTY

All hardware shall be guaranteed for a period of one year from the date of issue of completion certificate. Lever handles to be warrantied for a period of five years from the date of issue of completion certificate. Material shall be covered against manufacturing defects or breakage, will-full damage excluded.

The warranty shall include particular reference to failure of, or due to, the following:

Correct selection for required location performance

Correct functioning of moving parts.

Structural adequacy.

Chipping, fading, excessive wear or delamination or other deterioration of finishes.

Fixing and connectors including stripped threads and damaged heads.

Integrity of seals.

Sagging, slackness or looseness of knobs and handles due to wear, relaxation of springs, stripped threads, or any other cause.

The warranty shall include an undertaking that spare parts and replacement items will be available for sale off-the-shelf, or with a lead time not exceeding four weeks from date of order, for a period not less than the warranty period.

Warranty shall be accompanied by a current retail price list properly identified and dated. The

warranty shall include an undertaking with respect to price control for the following items:

Replacement keys.

Replacement cylinders.

1.7 MAINTENANCE INSTRUCTIONS

1.7.1 Provide maintenance data, parts lists and manufacturer's instructions for installation and maintenance for each type of hardware including door closer, lock case, exit devices, etc.

1.7.2 Provide 3 nos. copies of catalogues for all hardware used for incorporation into maintenance manual. Only original catalogue shall be used.

1.8 SELECTION

In as much as the items in the hardware schedule represent the Architect's / Engineer's selection pertaining to weight, method of fixing, design, finish, and function, alternatives will only be considered if, in their opinion, it equals or exceeds the set standard and quality of the hardware.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Manufacturers: Products listed in the hardware schedule are from the manufactures listed below or Architect approved equal.

Dorma GmbH +Co KG P.O. Box 4009 D-58247 Ennepetal, Germany	Lock cases, Cylinders, Door Closers and Floor Closers, Lever handles, Pull handles, TV Locks, Magnetic Shear Lock, Automatic swing door operators, Magic Switch, Door Contact etc.
Dorma Architectural Hardware DORMA Drive, Drawer AC, USA.	Door Closers, Exit Devices, Card Readers
Dorma Gulf Door Control FZE PO Box 17268 Jebel Ali Free Zone South Dubai, UAE	Hinges, kick plate, mop plate, Armor plate, structure plate, edge guard, flush bolts, door stops.
Dorma Productions GmbH No.2 Jalan Terusan, Jurong Singapore 619285	Door Closers, etc.
Kaba GmbH Ulrich-Bremi-Straße 2 3130 Herzogenburg Austria	Cylinders.
Madinoz Unit 3 1-7 Ada Avenue Brookvale NSW 2100	Coat hook
Lorient Polyproducts Ltd Endeavour House Fairfax Road Heathfield Ind Est Newton Abbot Devon TQ12 6UD United Kingdom	Weather Strip, Threshold

2.2 HARDWARE ITEMS

2.2.1 HINGES

Hinges and screws shall be suitable approved types and sizes.

Submit product information, and Control Sample if directed.

Coordinate with door and frame manufacturer for correct location of hinge recesses and screw holes.

Hinges shall be Dorma type 3094F, with hospital tip, suitable for the location and the intended function of the doors, including size and weight of the door, door swings and wind pressure, in accordance with the product information and relevant standards. Hinges to conform to EN 1935, Grade 13.

Hinges shall of a suitable type to match other items on the door, unless otherwise specified, hinge sizes to be 101.6mm x 101.6mm x 3mm. All hinges shall be fire rated, independently tested and certified and CE Marked.

Where specified for external outward opening doors, 3094F NRP hinges shall be used.

The number of hinges should be selected according to the door mass, door width, type of door closer and the grade of use of the door.

Aluminium hinges are not acceptable on timber and steel doors.

Where mortised hinges are using in fire rated timber doors shall be supplied with suitable intumescent seal.

2.2.2 PIVOTS

Pivots and screws shall be suitable approved types and sizes.

Submit product information, and Control Sample if directed.

Coordinate with door and frame manufacturer for correct location of pivot recesses and screw holes.

Pivots shall be suitable for the location and the intended function of the doors, including size and weight of the door, door swings and wind pressure, in accordance with the product information and relevant standards.

Where Specified offset hang pivots shall be 7471k floor bearing pivot, 7411/56 bottom door strap, 7411k/56 top frame centres.

2.2.3 DOOR CLOSERS

Door closers shall be approved types, suitable for the location and the intended function of the doors, including size and weight of the door, door swings and wind pressure, in accordance with the product information and relevant standards. All door closers to comply with EN 1154.

Door closers in public areas to be with full cover stainless steel. All visible surfaces of the door closers shall be stainless steel finish.

For non-public areas door closers shall be in silver finish.

Where the Fire rated doors are to be used by public, door closer should be Cam-action mechanism, to comply with the maximum opening force needed of 22.5 N at 30-60 degrees as per approved document M 2004 and simultaneously comply to minimum closing force as per BS 8300:2001 and comply to DIN SPEC 1104/CEN/TR 15894-2009-12 *(DIN SPEC 1104 advises the application of manually-operated fittings that reduce the opening resistance of a door by around 40% in the sweep range from 2 to 60 degrees thus to facilitate effortless door operation for children, the elderly and disabled people by enabling door to be opened with 40% less effort as compared to convention door closers)*

Submit product information, and Controlled Samples if required by the consultant.

Where specified use Door closers Dorma Type TS92 with Cushion Block size 3 with Slide track and arm. Suitable for fire and smoke check doors. Door closer to have two independent values force closing speed adjustment. Door closer to be CE marked.

For heavy or external doors where specified, use Cam-Action door closer Dorma type TS93, EN 2-5, 5 and 7 as per width and weight parameters of the door. Closing speed and latching speed shall be controlled by separate concealed key operated valves. External doors facing high wind conditions and internal doors likely to be opened with high forces shall be having back check to protect the door and adjacent wall damage. Door closers should have the delayed action feature to facilitate the extra time to close to allow differently abled people and people with trolleys and luggage.

Door closers to be CE marked.

For corridor doors, and doors having public area on both sides, use concealed Cam-Action door closer Dorma type ITS96 integrated in the door leaf or frame, tested to EN1154A, with rapidly decreasing opening torque. Closing strength, closing speed and latch action adjustable, non handed, with slide channel G96N20. For non fire rated doors, where required, use hold open unit integrated in slide channel arm RFG96N20.

For Non public areas, use TS73V, rack and pinion spring strength adjustable overhead closer, non-handed, hydraulic control from 180 degree, thermo-constant, pressure relief valve, separate sweep and latch value, self adjusting back-check for standard or fame installation on interior doors up to 1100mm wide doors. Finish as specified in hardware schedule. For external or heavy doors use TS83, rack and pinion door closer.

The door closers should be installed on the push side of doors opening to exterior. Where floor stops cannot be used, use Dorma Type 8616 door closers with Parallel Arm door Saver for push side installation and Integral Stop Arm for pull side installation to control opening of the door and prevent damage to the door leaf and adjacent walls. Use Dorma Type 7436 door closer with parallel arm door saver where wall or floor mounted door stops are not suitable.

Door closer to be of EN size 2-4 for doors up to 1100mm wide and 80kg weight.

Door closer to be of EN size 2-6 for doors up to 1400mm wide and 120kg weight.

Door closer to be of EN size 7 for door up to 1600mm wide and 160kg weight.

Where practicable, surface mounted closers shall be concealed from view by mounting inside rooms and stairwells. Do not fix closer to the visible side of public corridors, foyers or the like. In case it is desirable door closer not to be seen from both sides, Concealed type door closer to be used which is installed inside the cut out on frame or door and the closer is not visible from both sides of the door.

Where mortised door closers are using in fire rated timber doors shall be supplied with suitable intumescent seal.

2.2.4 FLOOR CLOSERS

Floor closers and controllers shall be approved types, suitable for the location and the intended function of the doors, including size and weight of the door, door swings and wind pressure, in accordance with the product information and relevant standards. Floor closers to conform to EN 1154.

Submit product information, and Controlled Samples if required.

Where site conditions do not allow for surface overhead door closer projections causing obstructions, or aesthetic conditions do not allow for overhead closers or conditions that do not allow for standard hinges use floor closers.

For door where floor closer is indicated or required, the floor closer to be Universal non-handed floor spring Dorma type BTS 80. Floor closer to be suitable for single and double door up to 300kg of door leaf weight. Floor closer to have adjustable closing speed, adjustable closing action, back check and hold open feature.

Where specified use Universal floor spring Dorma BTS75V conforming to DIN EN1154, non-handed unit suitable for single and double doors up to door leaf weight 120kg. Adjustable spring strength size EN 1-4, closing speed. Hydraulically fully controlled closing cycle and back-check. The cement box included with the floor spring. With optional hold open feature for non-fire rated doors at 90 and 105 degrees fixed.

The cover plate to be stainless steel, suitable for both left and right handed doors. Single action doors to have spindle with 3 degree offset for securely closing the door in windy conditions.

Where need, the floor closer to be installed with Terrazzo pans and interchangeable extended spindles to allow insertion of floor finish material in the pan to avoid sight of cover plates. Sealing compound to be used where non carpeted flooring is used.

Where specified for radiation rooms, the floor closer shall be heavy duty lead lined accessories.

The selection of the floor is to be considered in conjunction with the manufacturer's recommendations for selecting the right size for the floor closer.

Floor closers to be installed on fire rated doors are to be CE Marked.

2.2.5 LEVER HANDLE SETS

Lever handles shall be approved types, suitable for the location and the intended function of the doors.

Submit product information, and Controlled Samples if required.

Lever handle to be Dorma Ogro 8527 handle, with Dorma Ogro 6501 rose and Dorma Ogro 6612 escutcheon, Ogro 8020 for Knob. Dorma Ogro 7122WC for water closet doors with indicator. Sets to conform to EN 1906 category 4 for high level of usage in public area, with 10-year warrantee. The lever handle, roses and escutcheons to be in satin stainless steel finish.

Lever handles to be with 8mm spindle, secured by non-reversible spring clips into serrations located on spindle. The back plates to be of steel base and have extended depth, strong enough to transmit forces to the door leaf, and have a compensating collar with spring clip for easy but secure snap in installation. Fixing bolts to be back-to-back fixing, M5 bolts, with steel support lugs for precise retention of the assembly position and slip-free fitting of the furniture set to the door leaf. The fixing system should allow fast and easy pre-fitting of the mountings; roses shall be pre-fitted without lever handles. The roses should have clip on covers.

2.2.6 PULL HANDLES

Pull handles shall be approved types, suitable for the location and the intended function of the doors.

Submit product information, and Controlled Samples if required.

Pull handles to be with single side and back to back fixing as specified. Fixing to suit the material of the door. The standard concealed back to back fixings for timber and steel doors shall be suitable for door thickness from 35mm to 100mm. The fixing for glass doors shall be suitable for glass thickness from 8mm to 15mm.

Where specified for pull handles to be straight type Dorma TG9355, TG9830 for wood or metal doors as specified. And for narrow stile aluminium doors, the pull handles shall be of offset type Dorma TG9356.

Fixing shall be Dorma type GZ214 for back to back in wood/metal/aluminium door, Dorma type GZ216 for single sided in wood/metal/aluminium door,

2.2.7 MORTISE LOCKS

Locks and latches shall be approved types, suitable for the location and the intended function in accordance with the relevant standards.

Locks and latches to conform to EN 12209.

Submit product information, and Control Samples if directed.

Unless otherwise indicated, locksets and latch-sets shall be mortise type. Use only proprietary strike plates nominated for the required locks or latches.

All latch-sets and locksets shall be from one manufacturer, unless otherwise indicated.

Locks to be Dorma type 132 for non-fire rated dead bolt, Dorma type 132F for fire rated dead bolt, Dorma type 771 for non fire rated doors, Dorma 752F for fire rated doors, Dorma type 775 for Bathroom/WCs. For doors where only latching is required use, Dorma type 115-latch lock. For narrow style doors use, Dorma type 952, type 985 roller latch and type 917 dead bolt where specified. For disabled WC the lock type shall be Dorma type 150.

Where specified for **Radiation Protection Doors**, the lock set shall be **1017** with eccentric preparation for Euro profile cylinder and spindles.

Lock case to be sealed and zinc plated. Nickel Plated Latch and/or bolt. Bolt projection to be double throw, 20mm, with 8mm square steel follower mounted in drawn steel bushes. Springs and other moving parts not fabricated from brass shall be corrosion-resistant steel alloy or stainless steel. The forend to be 24mm width, square edges, of stainless steel material in satin finish. Locks to be for euro profile cylinders with 55mm back set. Latch should be steel material for Fire rated doors.

Where specified for narrow stile doors Mortise latch and deadbolt shall be with 8mm spindle follower, 92mm center distance, for Euro profile cylinder, 24mm square forend, 35mm backset, 20mm single throw bolt projection, conforming to DIN 18250-2, Class 3 with suitable strike plate

High frequency doors should have special bronze-bushed self-adjusting clamp follower for Rattle-free lever handles and maintenance free, lubricated silent pattern latch.

2.2.8 KEY AND CYLINDERS

Cylinders shall be approved types, suitable for the location and the intended function in accordance with the relevant standards.

Cylinders to be tested and certified to EN 1303, DIN 18252 and Vds.

Cylinders to be Euro-Profile keyed under a master key system, each cylinder to have 3 change keys. The cylinders shall be with 6 pairs of spring loaded brass tumbler pins, 9 mm cam with variable in 8 different positions. The cylinder should have a solid steel cam, special key way and special key profile with patented “Branch Groove”.

Keys shall resist a torque of 2.5Nm and still be usable. Cylinders shall be tested and certified to 100,000 cycles, fire tested in accordance with current fire test requirements of EN 1634-1. Corrosion and temperature resistance shall conform to grade 3 of BSEN 1670 and shall resist temperature extremes of -20/+80°C.

The cylinders shall have the highest grade of security (Grade 6) with a minimum number of 100,000 differs.

It shall have the highest attack resistance (Grade 2), to have an attack resistance to drilling for minimum 5 minutes, chisel attack for minimum 40 numbers, twisting attack for minimum 30 numbers, plug/cylinder extraction for minimum pull load 15kN and have a torque resistance of plug/cylinder for minimum 30 Nm.

Master keying to be done in factory and records maintained. Access to additional keys to be through authorised representative of owner only. The master key system should have 3 keys per cylinder and master keys based on key schedule approved by the consultant. Master keys provided per "Master Key Zone" numbers on door schedule (sheet A5.30 & A5.31). The system should have a capability of expansion of 50% for the future.

Where specified cylinders to have thumb-turn on one side. Exit devices which have a trim, should have single cylinder.

Cylinders shall be interchangeable between different manufacturers.

Cylinders shall be solid brass, and tumbler pins shall be nickel alloy steel.

Cylinders and keys shall be code stamped with an identification number in an approved location. Verify identification numbers with the Principal before stamping.

The Cylinder system shall be capable of master keying double cylinder, thumbturn cylinders, single cylinder, classroom function cylinder, American profile cylinder, padlock cylinder, furniture cylinder under one master key.

Double cylinders shall be Gege pExtra-DZ.
Thumb-turn cylinders shall be Gege pExtra-DKZ.
Single cylinders shall be Gege pExtra-HZ.
WC cylinders shall be Gege WCZ.
American profile cylinders shall be Gege pExtra-SCHR.Z.
Classroom function cylinders shall be Gege pExtra-DKZ with classroom function.

2.2.9 FLUSH BOLTS

Flush bolts shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information.

Submit product information, and Control Samples if directed.

Flush bolts to be TA 104MD for Metal doors and TA 104WD for Timber doors.

Dust Proof strike-TA 214 to receive the bolts.

Door with heights above 2200mm, to have extension bolt for the top manual flush bolt for easy access.

For aluminium doors use flush bolt of type GIESSE 2150 and strike GIESSE 2183

Lever action flush bolts appropriate to the type of the door i.e., Steel/wood/Aluminium should be used.

Suitability of the mortised flush bolt to be coordinated with exact door thickness and the other hardware on the door at the time of order.

Where mortised flush bolts are using in fire rated timber doors shall be supplied with suitable intumescent seal.

2.2.10 DOOR SEALS

Door seals to be self-adhesive silicone tear drop seals at jamb and header for internal doors. For external doors it shall be surface mounted with Silicon insert and rigid cover cap.

Door seals, including weather seals, smoke seals, acoustic seals and air seals, shall be suitable for the location and the intended function in accordance with the Product Information. Shall be tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for reliability, the seal completed 1,000,000 cycles without failure.

Submit product information, and Control Samples if directed.

Include fixings, rebates, grooves, and clearances for correct installation and operation of seals.

Coordinate with the door-frame manufacturer for required rebates to door-frames.

All external door to have suitable weather seals to protect against outside dust, wind and cold.

Door seals to be Lorient LAS1212 jamb and header weather seals for internal doors and Lorient LAS7001Si for external doors, and Lorient 410 meting stile seals for pair of doors.

For applications of auto door bottom use medium duty completely mortised model LAS8001 Si. Suitability of the mortised auto door bottom to be confirmed as per the exact door thickness at the time of order.

Where surface mounted auto door bottom specified shall be LAS8008 Si All auto door bottoms shall be tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS 9999. Suitable for use on timber fire doors for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 and BS EN 1634-1: 2014. Tested for reliability, the seal completed 1,000,000 cycles without failure. For lead lined doors installation should be coordinated with door manufacturer to avoid damage in leaded lining.

Where specified astragal for wooden door shall be HP410 meeting stile astragal, Tested for Fire, Positive pressure, Smoke and Draft control Gasketing, Acoustical tested, and Air infiltration tested.

Threshold type to be 4014Si Panic thresholds and 4011 saddle thresholds suitable for disabled people/persons in wheelchair.

Jamb and header seals proprietary to the aluminium door and frames to be used subject to the approval of the consultant. Jamb and header seals to be with pressure sensitive tape 6.4mm in charcoal finish.

2.2.11 MOP PLATES, KICK PLATES AND PUSH PLATES

All protection plates to be stainless steel 1.2mm thick.

Door protection plates shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information.

Submit product information, and Control Samples if directed.

Applied facings to doors and kick plates shall be approved types to match control samples.

Verify edge details on shop drawings before commencing.

Applied facings shall be factory bonded where practicable. Fully faced doors shall be factory matched with door-frames to minimise requirement for site adjustment.

Use water-resistant adhesive or other suitable concealed methods. No mechanical fixings shall be visible in the completed work. Finish exposed edges with smooth edges.

Unless otherwise indicated, width of applied facings shall be full width of door. Width may be reduced to clear doorstops, if approved before commencing.

Push Plate shall be satin stainless steel dormakaba TA 108A, 100 mm width x 400 mm high as specified.

Kick plates shall be satin stainless steel of size 200 mm height. Width as per door leaf width as specified.

Armor Plates shall be satin stainless steel of size 900 mm height and width as per door leaf width less 25mm as specified.

Mop Plates shall be satin stainless steel of size 150mm height and width as per door leaf width less 25mm.

For Double egress doors, the Mob plate height to be equal to the Kick plate.

Stretcher plate shall be satin stainless steel of size 150mm height or as specified.

Edge guard to be suitable for protection plates used in that door, Height as per the height of Armor plate and shape bevelled/non-bevelled as per door edge. Cut-outs as per flush bolts, hinge and lock conditions

Gender signs to be from dormakaba TA Series.

Door guards to be dormakaba TA 242 and door viewer to be TA 250.

2.2.12 DOOR STOPS

Door stops shall be approved proprietary types, suitable for the location and the intended function, in accordance with the Product Information.

Submit product information, and Control Samples if directed.

Provide door stops to limit door swing where indicated or required to prevent damage to adjacent work by uncontrolled door opening.

Verify floor or wall mounting locations before installation where not indicated. Do not mount door stops to un-reinforced lightweight walls.

Where stops for non-fire rated doors are not practicable, provide overhead stays to control door swing.

Door stops to be Dorma TA811 46mm diameter, 28mm height half dome stainless steel floor stop with black rubber insert for floor mounting type, Dorma TA062B 53 mm dia base, 75 mm long wall mounted stainless steel door stop with hard rubber insert. For locations where door stop cannot be installed on floor as well as wall, overhead door stop shall be used. Shall be Dorma 710 series for medium duty concealed applications, Dorma 700 series for medium duty surface mounted applications. Overhead door stops to be suitable for door width.

2.2.13 ELECTRONIC EXIT BOLT

Where specified electronic bolt shall be TV104 stainless steel for public area and TV 101 silver finish for non-public areas. Electronic exit bolt shall be fail safe with anti-tamper and door monitoring contacts and holding force of 6KN with jam free opening irrespective of load. Power supply unit shall be Dorma RZ01 stabilised 24VDC units. Maximum holding force shall be in accordance with “Requirements for electrical locking systems on doors in emergency escape routes”(German EltVTR code of practice).

Where specified for pull side application shall be with TVZ special bracket of size 190x87x58mm.

Where fail safe application surface mounted lock is specified, use Dorma electro magnetic lock, grade 1, surface mounted with 1650lb holding force, 350mA @ 24VDC, with door position switch feature.

2.2.14 MAGNETIC SHEAR LOCK

Where specified Shear lock shall be 2700 series, High shear model, 2700 pounds, fail safe, with lateral and vertical alignment adjustments, with built in field adjustable auto-relock switch and external time delay. 1-1/4" frame face, concealed installation. 24VDC, voltage kick back protection, built in door position and lock status sensors

2.2.15 POWER SUPPLY

Where specified power supply shall be Dorma RZ 01 power supply unit, 230 vAC +/- 10%, 16VA, max current output 600mA, IP class 21, with LED for status indication size 160x80x50mm. For Delayed Egress panic bars, use Power supply model AD100 for input 230V, output 24VDC, 1 Amp. surge for 1.5 seconds, 1 AMP continuous, per zone. Output circuit protection 2 AMP Push to reset circuit breaker. Enclosure size shall be 205mm high x 205mm wide x 100mm deep, NEMA 1 type enclosure for indoor use with hinged cover and knock-outs.

For Panic bars with other electrical functions MLR, use power supply PS502RF, input 230V, output 24VDC, 1 Amp.

2.2.15 DOOR STATUS SWITCH/DOOR CONTACT.

Use DORMA MC-4 door status switch at top jamb of frame at locations where specified, to monitor the door status remotely.

2.2.16 SWITCHES.

Where specified use Dorma manual release switch HT-UP wall concealed installation. Where specified use Dorma Key switch TL-ST PZ S55, surface mounted to EN60947-5-1, prepared for Euro-profile single cylinder DIN 18252, Locking cam centre 30-32mm, overall length 40.5-43.5, locking cam position 90 degree.

2.2.17 BREAK GLASS

TL-N S 55 Emergency break glass push button, System 55 format, LED illuminated, red emergency push button, with optical indicator of lock status (green/red), visual alarm with yellow flashing light for tamper/sabotage attempts, emergency push button operation, audible alarm via integral alarm siren, anti-tamper emergency push button with glass lens of shatter – proof safety glass. System to have stainless steel cover unit with adapter frames. There should be visual sign for indication of emergency exit, above the push button.

2.2.18 CABLE LOOP

Where specified concealed cable loops KU480 – robust stainless steel spiral metal sheath with recess channel for ducting of flexible connecting cables up to 8mm dia, with pinch free and tamper protected connection. Size 24x480x17mm and a pivot offset up to 36 mm. Shall be suitable for wood/metal/aluminium doors.

Where specified cable loop for surface mounted applications shall be KS370- size of 17x370x15mm and a pivot offset up to 36mm.

2.2.19 CARD READER

Where specified card reader shall be Delta 5.3-SCR Contact less card reader, integrated high security technology, 13.56 MHz line of contactless smartcard readers, cards, and tags fraudulent data detection solution, weigant output interface. . It shall be based upon p MIFARE contactless digital radio frequency identification (RFID) technology. It shall have value-added features such as MAXSecure and ValidID, and support sector and card serial number (CSN) reads. The cards and tags shall be passive devices, eliminating maintenance by requiring no battery. It shall be ordered programmed to various formats and encryption keys.

The reader shall be of size 83x83x20mm, to be with European wall mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.

2.2.20 MAGIC SWITCH

Where specified Magic switch shall be MICROWAVE TOUCHLESS SWITCH, 24VDC, output relay with switch-over contact voltage free, to be installed in recessed housing 65mm dia, 41mm deep (OR 81mm square). Where specified it shall be with Toggle option.

2.2.21 INTUMECENT SEALS

Where specified Fire-rated wood doors please used intumescent seals.

2.2.22 FASTENERS

Furnish all finish hardware with all necessary screw bolts and other fasteners as needed for anchoring the hardware in position, for long life.

All fastenings shall harmonise with the hardware with respect to the material and finish.

On lead lined doors no screws shall be used to fix door guard, push plate, kick plate, armour plate etc. use double-sided adhesive tape to fix the protection plates to prevent damage to the lead lining.

2.3 FINISHES

FINISH

SSS	-	Satin Stainless Steel finish
SCP	-	Satin Chrome Plated
SNP	-	Satin Nickel Plated
CH	-	Charcoal (for weather seals etc.)
SB	-	Satin Brass
Silver	-	Silver finish
Mill	-	Aluminium finish.

2.4 KEY CONTROL

Provide an approved proprietary lockable key cabinet with adequate compartments, pockets or hooks to accommodate all required keys

Each key shall be attached to an approved plastic key tag by a metal split ring, properly labelled with the final room name or number.

2.5 APPROVED SUPPLIERS

DORMA Gulf Door Controls FZE.
P.O. Box 17268,
Plot No S 20135,
Road No SW 301 G,
Jebel Ali Free Zone South,
Dubai, UAE

Tel : + 971 4 80 20 400
Fax : + 971 4 88 69 101
URL : www.dorma-gulf.com

PART 3 EXECUTION

1. INSTALLATION:

Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.

Install each hardware item in compliance with manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application or surface protection with finishing work specified in the Division –9 sections. Do not install surface mounted items until finishes have been completed on the substrate.

Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and Countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards. Set thresholds for exterior doors in fully bed of butyl-rubber or polyisobutylene mastic sealant.

2. PROTECTION

Provide secure lock-up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items which are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses both before and after installation.
Contractor shall protect hardware as it is stored on the construction site in a covered and dry place.
Contractor shall protect exposed hardware installed on doors during the construction phase.

3. ADJUST AND CLEAN

Adjust and check each operating item of hardware and each door, to ensure proper operations or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
Clean adjacent surfaces soiled by hardware installation.

Final Adjustment: Wherever hardware installations is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

4. HARDWARE SCHEDULE:

The attached Hardware schedule is furnished for whatever assistance it may afford the contractor. Do not consider it as entirely inclusive. Should any particular door or item be

omitted in any schedule hardware group, provide door or item with hardware same as required for similar purposes. Quantities listed are for each pair of doors; or for each single door.

---END OF SECTION---

PROJECT: Redemption Hospital
CONSULTANT:- MASS

QTY	UNIT	ITEM	CODE	PRODUCT	SUPPLIER or Architect Approved	FINISH
HARDWARE SET: 1				**Qty,Location and the door type as per the door schedule**		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
HARDWARE SET: 2				**Qty,Location and the door type as per the door schedule**		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
HARDWARE SET: 3A				**Qty,Location and the door type as per the door schedule**		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
HARDWARE SET: 3				**Qty,Location and the door type as per the door schedule**		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.

1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 4				Qty,Location and the door type as per the door schedule		
4	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Set	Lever handle	Ogro 8527/ 3020/ 6501/ 6612	Ogro spring assisted Lever handle with outside fixed knob, Non- handed configurations, securely bushed, steel mountings, with 55mm dia round roses and escutcheons, back to back fixing screws, compliant with EN -1906 category 3 and DN18273.	Dorma	SSS
1	ea	Electric strike	Fire 447/RR	Electric Strike,for fire and smoke check doors, FAIL SECURE, 24VDC, with strike plate and door monitoring contact. (Specify door material for the right strike).	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Set	Door contact	MC-4	Door Contact-Door position sensor, recessed mount 250mA @ 30V AC/DC, $22 AWG	Dorma	-
Note:-	Entry by card reader,exit always free,incase of power failure the door is locked from outside					

HARDWARE SET: 5				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Electro-mechanical lock	TV-104/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	SSS
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
Note:-	Entry by card reader,exit by push button,incase of power failure the door is unlocked					

HARDWARE SET: 6				Qty,Location and the door type as per the door schedule		
4	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 7				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

HARDWARE SET: 8				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Electro-mechanical lock	TV-101-Push side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	Silver
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
Note:-	Entry by card reader,exit by push button,incase of power failure the door is unlocked					

HARDWARE SET: 10				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

HARDWARE SET: 11				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	ea	Electric strike	Fire 447/RR	Electric Strike,for fire and smoke check doors, FAIL SECURE, 24VDC, with strike plate and door monitoring contact. (Specify door material for the right strike).	Dorma	SSS
1	Set	Lever handle	Ogro 8527/ 3020/ 6501/ 6612	Ogro spring assisted Lever handle with outside fixed knob, Non- handed configurations, securely bushed, steel mountings, with 55mm dia round roses and escutcheons, back to back fixing screws, compliant with EN -1906 category 3 and DN18273.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White
1	Set	Door contact	MC-4	Door Contact-Door position sensor, recessed mount 250mA @ 30V AC/DC, $22 AWG	Dorma	-
Note:-	Entry by card reader,exit always free,incase of power failure the door is locked					

HARDWARE SET: 12				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Electro-mechanical lock	TV-101/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	Silver
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS

1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
Note:-	Entry by card reader,exit by push button,incase of power failure the door is unlocked					

HARDWARE SET: 13				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

HARDWARE SET: 14				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Electro-mechanical lock	TV-104/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	SSS
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

Note:- Entry by card reader,exit by push button,incase of power failure the door is unlocked

HARDWARE SET: 14B				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Each	Electro-mechanical lock	TV-104-Push side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt.	Dorma	SSS
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 14A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Each	Electro-mechanical lock	TV-104-Push side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt.	Dorma	SSS
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

HARDWARE SET: 15				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

HARDWARE SET: 16				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Electro-mechanical lock	TV-104/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	SSS
1	Each	Magic Switch	Dorma Magic Switch	Magic Switch-MICROWAVE TOUCHLESS SWITCH, 24VDC, output relay with switch-over contact voltage free, to be installed in recessed housing 65mm dia, 41mm deep (OR 81mm square),	Dorma	White
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Automatic drop seal	LAS8001 Si	Medium duty recessed automatic drop seal. Tested for acoustics, fire and smoke, draughts and dust. Size size 14 x 35mm, 13mm max drop with grey silicone rubber. Length as per door width. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS 9999. Suitable for use on timber fire doors for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 and BS EN 1634-1: 2014. Tested for reliability, the seal completed 1,000,000 cycles without failure.(	Lorient	Silver Anodised Aluminium
1	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Set	Intumescent seals	IPK/ Hinges/ Locks	Intumescent protection for Hinges and Lock. Intumescent seals for door perimeter by door supplier.	INTERDENS® by BASF - Dr.Wolman GmbH	White

HARDWARE SET: 17				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
2	Each	Kick plate	D-KP Kick/DD	Kick plate stainless steel, 200mm high, width as per door leaf Width less.	Dorma	SSS
2	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 17A				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 18				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 19B				Qty,Location and the door type as per the door schedule		
2	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
2	Each	Magnetic Shear Lock	EMSL-2766	2700 series, High shear model, 2700 pounds, fail safe, with lateral and vertical alignment adjustments, with built in field adjustable auto-relock switch and external time delay. 1-1/4" frame face, concealed installation. 24VDC, voltage kick back protection, built in door position and lock status	Dorma	Satin aluminium
2	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
4	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	HP410	Adhesive meeting stile seal with intumescent material. Tested for fire and smoke. size 40x4mm and	Lorient	Grey

HARDWARE SET: 19A				Qty,Location and the door type as per the door schedule		
2	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
2	Each	Magnetic Shear Lock	EMSL-2766	2700 series, High shear model, 2700 pounds, fail safe, with lateral and vertical alignment adjustments, with built in field adjustable auto-relock switch and external time delay. 1-1/4" frame face, concealed installation. 24VDC, voltage kick back protection, built in door position and lock status	Dorma	Satin aluminium
2	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
4	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	HP410	Adhesive meeting stile seal with intumescent material. Tested for fire and smoke. size 40x4mm and	Lorient	Grey

HARDWARE SET: 19				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS

2	Each	Electro-mechanical lock	TV-101-Push side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	Silver
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
2	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 21				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
2	Each	Electro-mechanical lock	TV-104-Push side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt.	Dorma	SSS
2	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
2	Each	Magic Switch	Dorma Magic Switch	Magic Switch-MICROWAVE TOUCHLESS SWITCH, 24VDC, output relay with switch-over contact voltage free, to be installed in recessed housing 65mm dia, 41mm deep (OR 81mm square),	Dorma	White
1	Set	Door contact	MS-18	Door Contact-Mortise lock dead bolt monitor , SPDT.contact , 5A @30 VAC.	Dorma	-
2	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Each	Break Glass	TL-N S 55	Break Glass-Surface-mounted emergency pushbutton, system 55, with LED-illuminated, red emergency pushbutton to EN 60947-5-1, with +ve opening action, brightly lit emergency pushbutton surround with optical indicator of the lock status, visual alarm provided by yellow flashing light to signal tamper/sabotage and emergency pushbutton operation, Audible alarm. Anti-temper emergency pushbutton cover with glass lens of shatter-proof safety glass.	Dorma	Silver
1	Set	Lamp Indicator	BL 01	BL 01 Flashing Lamp, impact proof to DIN 40050, to indicate the door is locked.	Dorma	RAL
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Set	Auto Swing door Op'r	ED250/DD - Full Energy-Pull Side	ED250 EN 4-6 electro mechanical swing door operator for Double doors, for maximum door weight of 250 Kg, with DORMA IRS-2-33/70/90/120 infrared safety sensors (mounting on the hinge and opposite hinge side). Variable opening angle up to 110 degrees, integral sequential closing control. Power consumption, max. 240W, Supply Voltage 230 V, 50/60 Hz. With Upgrade Card Full Energy. Pull	Dorma	Silver
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 22				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Set	Door Closer,Concealed	ITS96-EN 2-4 G96GSR/ MK396	Door Closer, Concealed.-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Slide channel assembly, Concealed Cam-action door closer, Adjustable Closing and latching speeds. Cushioned limit stay. Door coordinator(GSR), MK 396 carry bar. Up to 120Â° opening angle.	Dorma	Silver
1	Each	Door Viewer	TA 250	180 degree door viewer fits in 14mm bore with cap inside.	Dorma	SCP
2	Each	Automatic drop seal	LAS8008 Si	Medium duty face fixed automatic drop seal with curve cover plate. Tested for acoustics, fire and smoke, draughts and dust. Size size 14 x 65mm, 13mm max drop with grey silicone rubber. Length as per door width. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS 9999. Suitable for fire doors up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 and BS EN 1634-1: 2014.Tested for reliability, the seal completed	Lorient	Silver Anodised Aluminium
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 23				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer,Concealed	ITS96-EN 2-4 G96N20	Door Closer, Concealed.-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Slide channel assembly, Concealed Cam-action door closer, Adjustable Closing and latching speeds. Cushioned limit stay. Up to 120Â° opening angle.	Dorma	Silver
2	Each	Automatic drop seal	LAS8008 Si	Medium duty face fixed automatic drop seal with curve cover plate. Tested for acoustics, fire and smoke, draughts and dust. Size size 14 x 65mm, 13mm max drop with grey silicone rubber. Length as per door width. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS 9999. Suitable for fire doors up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 and BS EN 1634-1: 2014.Tested for reliability, the seal completed	Lorient	Silver Anodised Aluminium
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 24				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 F Dead bolt lock	Mortise lock for Fire rated doors, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 25				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094F-2BB-HT	Hinges-101.6mm x101.6mmx 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, conforming to BS EN 1935, with CE Mark, suitable for use on fire/ smoke check doors up to 120 kg, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock	752 F lock	Mortise lock for Fire rated doors, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24 mm square forend, 55mm backset, 20mm double throw bolt projection. Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 26				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS

HARDWARE SET: 26A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum

HARDWARE SET: 27				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 28				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 29				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Gasketting	LAS7001Si-5.5m	Perimeter Seal for single door with flexible grey silicone rubber. Tested for fire, Positive pressure, Smoke and Draft control gasketing, Acoustics, Air infiltration. Jamb and Header jamb Seals of size 27x6mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for reliability, the seal completed 1,000,000 cycles without failure.	Lorient	Silver Anodised Aluminium
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 30				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 30A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS

1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 31				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 32				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum

HARDWARE SET: 33				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 34				Qty,Location and the door type as per the door schedule		
4	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 35				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum

HARDWARE SET: 36				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Electro-mechanical lock	TV-104-Push side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
1	Each	Break Glass	TL-N S 55	Break Glass-Surface-mounted emergency pushbutton, system 55, with LED-illuminated, red emergency pushbutton to EN 60947-5-1, with +ve opening action, brightly lit emergency pushbutton surround with optical indicator of the lock status, visual alarm provided by yellow flashing light to signal tamper/sabotage and emergency pushbutton operation, Audible alarm. Anti-temper emergency pushbutton cover with glass lens of shatter-proof safety glass.	Dorma	Silver
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS

HARDWARE SET: 37				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni

1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 38				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	SSS
1	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Electro-mechanical lock	TV-104/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	SSS
1	Each	Push button	HT	Push button for concealed mounting.	Dorma	SSS
1	Each	Card Reader	Delta 5.3-SCR	Contact less card reader, integrated high security technology, fraudulent data detection solution, weigant output interface. Size 83x83x20mm, European walll mount box. Certified to 1CC, FCC, and CE. IP rating of IP67. with 4 state LED indicator.(each) .	Dorma	Black
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	

HARDWARE SET: 39A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 39				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 40A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS

HARDWARE SET: 40				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS

HARDWARE SET: 41A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 41				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 42				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS

HARDWARE SET: 43				Qty,Location and the door type as per the door schedule		
4	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 44				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 45				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 45A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 46				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	Silver
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 46A				Qty,Location and the door type as per the door schedule		
1	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown

HARDWARE SET: 46B				Qty,Location and the door type as per the door schedule		
1	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
2	Each	Stretcher Plate	D-SP Stretchre/SD	Stretcher plate stainless steel, 152mm high, width as per door leaf width less 38mm.	Dorma	SSS
2	Each	Edge Guard	KE 30	Edge guard to be suitable for protection plates used in that door, Height as per the height of Armor plate and shape bevelled/non-bevelled as per door edge. Cutouts as per flush bolts, hinge and lock	Trimco	SSS
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 48				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock	771 Lock	Mortise lock, LATCH and DEADBOLT, 8mm spindle follower, for Euro profile cylinder, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Door Closer	TS73V/RA	Door Closer-Adjustable power EN 2-4, Certified to EN 1154, CE Marked, Scissor arm, Rack and pinion, Full cover, Adjustable Closing and Latching speeds. With Back check as a standard feature, Pull side	Dorma	Silver
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 49A				Qty,Location and the door type as per the door schedule		
2	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS

4	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	HP410	Adhesive meeting stile seal with intumescent material. Tested for fire and smoke. size 40x4mm and	Lorient	Grey

HARDWARE SET: 49				**Qty,Location and the door type as per the door schedule**		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ Classroom function	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK - Thumb turn retracts dead bolt and no locking by the thumb turn.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 50				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium

HARDWARE SET: 50A				Qty,Location and the door type as per the door schedule		
2	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
4	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	HP410	Adhesive meeting stile seal with intumescent material. Tested for fire and smoke. size 40x4mm and	Lorient	Grey
1	Each	Threshold	LAS4011	Saddle threshold suitable to prevent rain, draught and smoke penetration. Wheelchair friendly. Size of 100x6mm length as per door width.	Lorient	Silver

HARDWARE SET: 51A				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104WD	Brass flush bolt suitable for Wooden doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
2	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
2	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
2	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 51				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 52A				Qty,Location and the door type as per the door schedule		
2	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
4	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
4	Each	Armor Plate	D-AP Armor	Armor plate stainless steel, 900mm high width as per door leaf width less 25mm	Dorma	SSS
4	Each	Edge guard	D-EG Edge	Edge guard to be suitable for protection plates used in that door, Height as per the height of protection plate and shape bevelled/non-bevelled as per door edge. Cutouts as per flush bolts, hinge	Dorma	SSS

HARDWARE SET: 52				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
2	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
2	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
2	Each	Armor Plate	D-AP Armor	Armor plate stainless steel, 900mm high width as per door leaf width less 25mm	Dorma	SSS
2	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
4	Each	Edge guard	D-EG Edge	Edge guard to be suitable for protection plates used in that door, Height as per the height of protection plate and shape bevelled/non-bevelled as per door edge. Cutouts as per flush bolts, hinge	Dorma	SSS

HARDWARE SET: 58A				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door Closer	TS93B-EN 2-5 G93N Pull side	Door Closer-Adjustable power EN 2-5, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. With Adjustable Backcheck and Delayed action as standard features. Pull side installation. Up to 180Â° opening angle.	Dorma	Silver
2	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 58				Qty,Location and the door type as per the door schedule		
2	Set	Floor Closer	BTS75V/DA	Floor Closer-Adjustable size EN 1-4, Certified to EN1154, CE Marked, with DOUBLE ACTING accessories, for 120 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound DORMA 2300.	Dorma	SSS
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
4	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
4	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
4	Each	Stretcher Plate	D-SP Stretchre/SD	Stretcher plate stainless steel, 152mm high, width as per door leaf width less 38mm.	Dorma	SSS
4	Each	Edge guard	D-EG Edge	Edge guard to be suitable for protection plates used in that door, Height as per the height of protection plate and shape bevelled/non-bevelled as per door edge. Cutouts as per flush bolts, hinge	Dorma	SSS
4	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	set	Gasketting	LAS1212/ HP410 - 6.5m	Self-adhesive Batwing seals for Double door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 6.5m length .Meeting stile seal of size 40x4mm and 2.2m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 without compromising fire resistance.	Lorient	Dark Brown

HARDWARE SET: 59				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Flush Bolt	TA 104MD	Brass flush bolt suitable for Metal doors. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the door at the time of order)	Dorma	SCP
1	Each	Dust proof strike	TA 214	Brass dust proof strike	Dorma	SCP
1	Each	Lock,Deadbolt	132 Dead bolt lock	Mortise lock, DEAD BOLT only for Euro profile cylinder, throughbolt protection sleeves, 24mm square forend, 55mm backset, 20mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 021 square strike plate.	Dorma	SSS
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6612	Circular Europrofile Cylinder Escutcheon, 55mm dia, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 60				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock, WC	775 WC	Mortise lock for bathroom W/C, LATCH AND DEADBOLT, 8mm spindle follower, for WC indicator, 24mm square forend, 55mm backset, 10mm single throw bolt projection, Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Set	Lever Handle	Ogro 8527/ 6501/ 7122WC	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, Round WC INDICATOR, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Coat Hook	CH 425	Coat Hook with projection of 72mm and base 50x35mm.	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 60A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock, WC	775 WC	Mortise lock for bathroom W/C, LATCH AND DEADBOLT, 8mm spindle follower, for WC indicator, 24mm square forend, 55mm backset, 10mm single throw bolt projection, Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Set	Lever Handle	Ogro 8527/ 6501/ 7122WC	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, Round WC INDICATOR, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Coat Hook	CH 425	Coat Hook with projection of 72mm and base 50x35mm.	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 61				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock, WC	775 WC	Mortise lock for bathroom W/C, LATCH AND DEADBOLT, 8mm spindle follower, for WC indicator, 24mm square forend, 55mm backset, 10mm single throw bolt projection, Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Set	Lever Handle	Ogro 8527/ 6501/ 7122WC	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, Round WC INDICATOR, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Over Head Door Stop	712S	Standard duty concealed mounted overhead stop, with built in cushioned stop, non-handed, conforms to ANSI A 156.8 Grade 3,suitable for a door opening width from 689mm to 914mm.	Dorma	Alum
1	Each	Coat Hook	CH 425	Coat Hook with projection of 72mm and base 50x35mm.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 61A				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock, WC	775 WC	Mortise lock for bathroom W/C, LATCH AND DEADBOLT, 8mm spindle follower, for WC indicator, 24mm square forend, 55mm backset, 10mm single throw bolt projection, Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Set	Lever Handle	Ogro 8527/ 6501/ 7122WC	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, Round WC INDICATOR, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Over Head Door Stop	712S	Standard duty concealed mounted overhead stop, with built in cushioned stop, non-handed, conforms to ANSI A 156.8 Grade 3,suitable for a door opening width from 689mm to 914mm.	Dorma	Alum
1	Each	Coat Hook	CH 425	Coat Hook with projection of 72mm and base 50x35mm.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 62				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock, WC	775 WC	Mortise lock for bathroom W/C, LATCH AND DEADBOLT, 8mm spindle follower, for WC indicator, 24mm square forend, 55mm backset, 10mm single throw bolt projection, Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS
1	Set	Lever Handle	Ogro 8527/ 6501/ 7122WC	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, back to back fixing screws, click &go fast fixing modular mechanism, maintenance free sleeve bearing, Round WC INDICATOR, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Coat Hook	CH 425	Coat Hook with projection of 72mm and base 50x35mm.	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS

HARDWARE SET: 63				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	7436DS/COV	Door Closer-Adjustable power size 3-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Full cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	Alum
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4014 Si	Heavy duty Bumper Seal Threshold 125 x 13mm, with grey silicone bumper seal , Acoustical tested, Positive pressure and Air infiltration tested, length as per door width.	Lorient	Silver Anodised Aluminium
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 64				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Lock, WC	150 WC Dead bolt	Mortise lock for bathroom W/C, DEADBOLT only , through bolt protection sleeves, for WC indicator, 24mm square forend, 55mm backset, 10mm double throw bolt projection, Conforms to DIN 18251-1, Class 3, with 020 square strike plate.	Dorma	SSS

1	Set	WC Indicator	Ogro 7122WC	Circular, 55mm dia, back to back fixing, WC indicator and thumb turn inside.	Dorma	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 20 mm dia, 150mm long, 65mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Pull Handle	TG9355/ GZ216/ Horizontal	Straight Pull Handles U-shaped, 32 mm dia, 700mm long, 85mm projected from door surface, with Single-sided through-bolt fixing. Installed horizontally.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Over Head Door Stop	712S	Standard duty concealed mounted overhead stop, with built in cushioned stop, non-handed, conforms to ANSI A 156.8 Grade 3,suitable for a door opening width from 689mm to 914mm.	Dorma	Alum
1	Each	Gender Sign	TA 507	Restroom DISABLED sign in 100mmx100mm square stainless steel plate. Fixed used countersunk	Dorma	SSS

HARDWARE SET: 65				**Qty,Location and the door type as per the door schedule**		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	8616DS/FMC	Door Closer-Adjustable power size 1-6, Certified to ANSI 156.4 Grade 1. Door Saver Parallel Arm , Rack and pinion, Aluminium body, with Full metal cover, Adjustable Closing and Latching speeds, with slim plastic cover. With Back check as a standard feature, Push side installation.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 66A				**Qty,Location and the door type as per the door schedule**		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 66				Qty,Location and the door type as per the door schedule		
3	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
1	Each	Push Plate	TA018A	Push plate of size 100x400x1.2mm	ea	SSS
1	Each	Pull Handle	TG9355/ GZ216	Straight Pull Handles U-shaped, 32 mm dia, 350mm long, 85mm projected from door surface, with Single-sided through-bolt fixing.	Dorma	SSS
1	Each	Door Closer	TS92B/Pull Side	Adjustable power EN 1-4, Certified to EN 1154, CE Marked, Slide channel assembly, Cam-action, Adjustable Closing and latching speeds. Pull side installation. Up to 180° opening angle.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
1	Each	Door Wall Stop	TA 062B	53 mm dia base, 75 mm long , wall mounted stainless steel door stop with hard rubber insert.	Dorma	SSS
1	Each	Gender Sign	TA 505/ TA 506	Restroom gender sign (MALE/FEMALE) in 100mmx100mm square stainless steel plate. Fixed used countersunk screws.	Dorma	SSS

HARDWARE SET: 67				Qty,Location and the door type as per the door schedule		
6	Each	Hinges	3094-2BB-HT	Hinges-101.6mm x 101.6mm x 3mm, 2 ball bearing, stainless steel, template drilled, button tipped five knuckle butt hinge, Hospital Tip	Dorma	SSS.
4	Each	Magic Switch	Dorma Magic Switch	Magic Switch-MICROWAVE TOUCHLESS SWITCH, 24VDC, output relay with switch-over contact voltage free, to be installed in recessed housing 65mm dia, 41mm deep (OR 81mm square),	Dorma	White
2	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 350mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Set	Auto Swing door Op'r	ED250/DD - Full Energy-Push Side	ED250 EN 4-6 electro mechanical swing door operator for Double doors, for maximum door weight of 250 Kg, with DORMA IRS-2-33/70/90/120 infrared safety sensors (mounting on the hinge and opposite hinge side). Variable opening angle up to 110 degrees, integral sequential closing control. Power consumption, max. 240W, Supply Voltage 230 V, 50/60 Hz. With Upgrade Card Full Energy.	Dorma	Silver
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS

HARDWARE SET: 68				Qty,Location and the door type as per the door schedule		
2	Set	Pivots	7471k, 7411/56, 7411k/56,	Floor pivot with fixed spindle with ball bearing, 36mm offset bottom strap, and top center strap with cover. HANDED	Dorma	Silver
1	Pair	Flush Bolt	2150/300mm	Aluminium flush bolt - 300mm long including cover plate 2151 and rod 2158. (suitability of the mortised flush bolt to be confirmed as per the exact door thickness and the other hardware on the	Gissee	Alum
1	Each	Dust proof strike	2183	Aluminium dust proof strike.	Gissee	SCP
1	Each	Lock (Narrow stile)	917	Narrow stile Mortise DEADLOCK, for Euro profile cylinder, 181mm x 24mm square forend, 35mm backset, 20mm single throw bolt projection, with hardened steel rollers, with strike plate.	Dorma	SSS
1	Each	Electro-mechanical lock	TV-104/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	SSS
1	Each	Break Glass	TL-N S 55	Break Glass-Surface-mounted emergency pushbutton, system 55, with LED-illuminated, red emergency pushbutton to EN 60947-5-1, with +ve opening action, brightly lit emergency pushbutton surround with optical indicator of the lock status, visual alarm provided by yellow flashing light to signal tamper/sabotage and emergency pushbutton operation, Audible alarm. Anti-temper emergency pushbutton cover with glass lens of shatter-proof safety glass.	Dorma	Silver
4	Each	Magic Switch	Dorma Magic Switch	Magic Switch-MICROWAVE TOUCHLESS SWITCH, 24VDC, output relay with switch-over contact voltage free, to be installed in recessed housing 65mm dia, 41mm deep (OR 81mm square),	Dorma	White
1	Each	Magic Switch	Dorma Magic Switch (Toggle)	Magic Switch-MICROWAVE TOUCHLESS SWITCH, 24VDC, output relay with switch-over contact voltage free, to be installed in recessed housing 65mm dia, 41mm deep (OR 81mm square), with	Dorma	White
1	Set	Lamp Indicator	BL 01	BL 01 Flashing Lamp, impact proof to DIN 40050, to indicate the door is locked.	Dorma	RAL
1	Set	Door contact	MS-18	Door Contact-Mortise lock dead bolt monitor , SPDT.contact , 5A @30 VAC.	Dorma	-
2	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Cylinder	Gege pExtra-DKZ	Europrofile Cylinder 35/35mm with knob thumb turn one side, 6 pin tumblers under GMK.	KABA	Ni
1	Pair	Escutcheon	Ogro 6679	Oval/Narrow style Europrofile Cylinder Escutcheon, 69x31mm, back to back fixing.	Dorma	SSS
2	Pair	Pull Handle	TG9356/ GZ214	Curved Pull Handles Offset, 32 mm dia, 250mm long, 85mm projected from door surface, with back to back through-bolt fixing.	Dorma	SSS
1	Set	Auto Swing door Op'r	ED250/DD - Full Energy-Push Side	ED250 EN 4-6 electro mechanical swing door operator for Double doors, for maximum door weight of 250 Kg, with DORMA IRS-2-33/70/90/120 infrared safety sensors (mounting on the hinge and opposite hinge side). Variable opening angle up to 110 degrees, integral sequential closing control. Power consumption, max. 240W, Supply Voltage 230 V, 50/60 Hz. With Upgrade Card Full Energy.	Dorma	Silver
2	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Set	Weather seals	-	Weather seals by aluminium door supplier	-	-

Note: *The door is normally closed and locked. The door will open by Magnetic Switches inside and outside or by built in sensors in operator.The additional Toggle Magnetic switch shunts on/off the operator from inside to control unwanted entry during operation process. In case of power failure the door become push pull door. When the door is locked manually Access is allowed by key in manual lock, or exit by thumb turn inside.When the door is manually locked, the Lock monitoring switch shunts operatiing of the Operator.*

On-Site power supply, as specified above, to be used for ED250 - Auto Swing Door Operator.

HARDWARE SET: 69				Qty,Location and the door type as per the door schedule		
1	Set	Floor Closer	BTS80F/SA/ LL	Floor Closer-Size EN 4, Certified to EN1154, CE Marked, with SINGLE ACTING accessories 19mm offset for LEAD -LINED Doors, for up to 300 kg door leaf weight, Fire and smoke rated, Adjustable closing and latching speeds, Non handed, Backcheck, Floor concealed installation, with Sealing compound	Dorma	SSS
1	Each	Lock (Lead lined)	1017	Mortise LATCH and DEADBOLT for Radiation Protection Doors, with 40/ 80mm backsets, two 8mm spindle followers, with two cut outs for Half Euro profile cylinders, 72mm center distances, 24mm square forend, 22mm double throw bolt projection, with strike plate.	BMH	SSS
1	Each	Electro-mechanical lock	TV-104/TV-Z Pull Side	Electro-mechanical door locking element(failsafe) with anti-tamper and door monitoring contacts, integrated positive-action monitoring for active/inactive status, housed in anti-corrosion and anti temper metal enclosure in Contour Design, 24V DC, 250mA, 190x58x87mm with pull side bracket along with metal enclosure in contour design of size 190x58x87mm. Max holding force as per Requirement for electrical locking systems on doors in emergency routes with load independent jam-free unlocking. High mounting tolerance due to 360 degree flexible construction of the bolt	Dorma	SSS
1	Each	Power Supply	RZ 01/220V	RZ01 Power supply unit, stabilized 24V DC power supply unit, 220V AC, (+/- 10%, 16VA, max. current output 600mA.	Dorma	
2	Each	Break Glass	TL-N S 55	Break Glass-Surface-mounted emergency pushbutton, system 55, with LED-illuminated, red emergency pushbutton to EN 60947-5-1, with +ve opening action, brightly lit emergency pushbutton surround with optical indicator of the lock status, visual alarm provided by yellow flashing light to signal tamper/sabotage and emergency pushbutton operation, Audible alarm. Anti-temper emergency pushbutton cover with glass lens of shatter-proof safety glass.	Dorma	Silver
1	Set	Lamp Indicator	BL 01	BL 01 Flashing Lamp, impact proof to DIN 40050, to indicate the door is locked.	Dorma	RAL
1	Each	Cable loop	KU480	Concealed cable loop.	Dorma	SCP
1	Each	Cylinder	Gege pExtra-HZ	Europrofile Single cylinder 10/35mm, 6 pin tumblers under GMK.	KABA	Ni
1	Each	Single thumbturn	Gege Single thumbturn DKHZ	Single thumbturn cylinder 10/30mm.	kaba	Ni
1	Set	Lever Handle	Ogro 8527/ 6501/ 6612-SP	Ogro spring assisted Lever handle, flat curved design, with 55mm dia round roses and escutcheons, with 9mm split spindle (length as per door thickness). Click &go fast fixing modular mechanism, maintenance free sleeve bearing, compliant with EN -1906 category 4 and DN18273, non handed .	Dorma	SSS
1	Each	Stretcher Plate	D-SP Stretchre/SD	Stretcher plate stainless steel, 152mm high, width as per door leaf width less 38mm.	Dorma	SSS
1	Each	Kick plate	D-KP Kick/SD	Kick plate stainless steel, 200mm high, width as per door leaf Width less 38mm.	Dorma	SSS
1	Each	Mop Plate	D-MP Mop	Mop plate stainless steel, 152mm high, width as per door leaf width less 25mm	Dorma	SSS
4	Each	Edge guard	D-EG Edge	Edge guard to be suitable for protection plates used in that door, Height as per the height of protection plate and shape bevelled/non-bevelled as per door edge. Cutouts as per flush bolts, hinge	Dorma	SSS
1	Each	Automatic drop seal	LAS8008 Si/ Lead lined	Medium duty face fixed automatic drop seal with curve cover plate. Tested for acoustics, fire and smoke, draughts and dust. Size size 14 x 65mm, 13mm max drop with grey silicone rubber. Length as per door width. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS 9999. Suitable for fire doors up to 60 minutes under conditions of BS 476: Pt.20/22: 1987 and BS EN 1634-1: 2014.Tested for reliability, the seal completed 1,000,000 cycles without failure. (Installtion of drop seal should be coordinated with door	Lorient	Silver Anodised Aluminium
1	Each	Door stop	TA 811	46mm diameter 28mm height half dome stainless steel floor stop with black rubber insert.	Dorma	SSS
1	Each	Gasketting	LAS1212-5.5m	Self-adhesive Batwing seals for Single door, Tested for fire, Positive pressure, Edge sealing system, Smoke and Draft control gasketing, Acoustics, and Air infiltration. Dark brown color, Jamb and Header Seals of size 12x12mm and 5.5m length. Tested for acoustic performance with BS EN ISO 10140-2: 2010. Meets the smoke leakage performance requirements of BS9999 when tested in accordance with BS 476 Pt 31.1: 1983. Tested for up to 60 minutes under conditions of BS 476: Pt.20/22: 1987	Lorient	Dark Brown
1	Each	Threshold	LAS4011	Saddle threshold suitable to prevent rain, draught and smoke penetration. Wheelchair friendly. Size of 100x6mm length as per door width.	Lorient	Silver

Note: *Magnetic lock, locks when the equipment in operation, Breakglass inside and outside, provides Emergency exit or access.*

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

1. Glass and glazing for the following:

a. Windows.
b. Doors.
c. Interior borrowed lites.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For glass and glazing sealants, for tests performed by a qualified testing agency. Obtain from manufacturer.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

B. Preconstruction adhesion and compatibility test report. Obtain from manufacturer.

1.5 QUALITY ASSURANCE

A. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program. Obtain from manufacturer.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated. Obtain from manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide basis of design product or comparable product by one of the following:

1. Viracon, Inc. as basis of design.
2. Berkowitz, JE, LP.
3. Guardian Industries Corp.
4. Oldcastle Building Envelope.
5. Saint-Gobain Corporation.
6. Vitro Architectural Glass.

B. Source Limitations for Glass and Glazing Accessories: Obtain from single source from single manufacturer for each glass type.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following:

1. Defective manufacture, fabrication, or installation.
2. Failure of sealants or gaskets to remain watertight and airtight.
3. Deterioration of glazing materials; or other defects in construction.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with SANS 1263-1.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 795.
b. GE Advanced Materials - Silicones; SilPruf NB SCS9000.
c. Architect approved equivalent.

2.5 GLAZING TAPES

A. 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

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where indicated on Drawings.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 GLASS SCHEDULE

A. Glass Type GL-1: Clear heat-strengthened, fully tempered float glass.

1. Minimum Thickness: 6.3 mm.
2. Safety glazing required by Building Code.

B. Glass Type GL-2: Clear fully tempered float glass.

1. Minimum Thickness: 6.3 mm.

END OF SECTION 088000

SECTION 089000 - INSECT SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insect screens for exterior wall openings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of metal finish required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Screen cloth: Wire Mesh.

1. Class: Insect Screen.
2. Mesh: 2.54 cm by 2.54 cm.
3. Wire Diameter: 0.5842 mm.
4. Material: Stainless steel T304.
5. Coating: White polyester coated.
6. Opening Area: 52%.
7. Weave Type: PSW.
8. Size: Field determined.

B. Screen Support and Finish: Refer to Architectural drawings.

1. Windows: Screening assembly on outside.
2. Louvers and other openings: Screening assembly on inside face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place insect screen assemblies level, plumb, and at indicated alignment with adjacent work.

B. Protect unpainted surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

C. Use concealed anchorages.

3.2 ADJUSTING AND CLEANING

A. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

B. Restore screen assemblies damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089000

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
3. Show mullion profiles and locations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Basis of Design: Aluminum Factory; Horizontal, Drainable-Blade Louver.

2.4 CONSTRUCTION:

A. Material: Mill Finish 6063-T5 extruded aluminum.

1. Frame: Mechanically fastened, minimum 2.9 inches (72 mm) deep x 0.081” thick channel.
2. Blades: Minimum angle 37-1/2 degress x 0.081 inch thick horizontal dual-drainable style.
3. Screen: Minimum 1 inch x 0.063 inch expanded and flattened aluminum. 18-by-16 mesh aluminum insect screen for each louver.

B. Minimum Performance Data:

1. Based on testing 48-inch x 48-inch size unit in accordance with AMCA 500L.
2. Free Area: 57.5% nominal.
3. Free area size: 9.2 ft².

4. Maximum Recommended Air Flow thru Free Area: 1113 fpm.
5. Air Flow: 10,242 cfm.
6. Maximum Pressure Drop: 0.15 in. wg.
7. Water penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 1113 fpm free area velocity when tested for 15 minutes.

C. Design Load:

1. Wind Load: Louver designs shall withstand the effects of 25 psf (1.2 kPa) of uniform pressure acting inward or outward.
2. Seismic Performance: Louvers, including attachments to other construction, shall withstand seismic effects determined by ASCE-7.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Include supports, anchorages, and accessories required for complete assembly.

D. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer flat finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 090511 - CONCRETE FLOOR PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mechanical cleaning of new concrete floor surfaces for application of the following finishes:

a. Sealers.
b. Coatings.
c. Polymer overlays.

1.3 ADMINSTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Review conditions affecting substrate preparation.
2. Review procedures that will be used for substrate preparation.
3. Require attendance by finish flooring installers to review preparation requirements of floor finish product and flooring adhesive manufacturers

1.4 ACTION SUBMITTALS

A. Product Data: For each type of mechanical cleaning equipment used on the project.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer performing surface preparation.

B. Field quality-control reports.

1. Submit report of observations.
2. Certify installation is complete in accordance with manufacturer’s instructions.
3. Indicate supplementary instructions provided for Project specific conditions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained in the use of the equipment and techniques required to produce the specified results.

B. Mockups: Provide field mockups to set quality standards for surface preparation execution and for preconstruction testing.

1. Provide mockup of typical surface preparation, minimum 100 sq. ft. area. Coordinate required size with requirements for preconstruction testing.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work when undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify new concrete floors have cured minimum 28 days.

B. Examine substrates, with Installer present, for compliance with requirements for surface contamination, damage, and other conditions affecting performance of the Work.

C. Examine substrate to determine repairs required to restore substrate surface to be within tolerances required for floor finishes specified in other sections, prior to completing Work of this section.

D. Examine substrate to verify surfaces prepared in accordance with this section will be suitable for application of finishes specified in other sections.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance with recommendations for methods and materials required to correct conditions before proceeding with work of this section.

F. Proceed with surface preparation only after unsatisfactory conditions have been corrected.

1. Proceeding with surface preparations indicates acceptance and of surfaces and conditions of substrate.

3.2 SURFACE PREPARATION EQUIPMENT

A. Mechanical Cleaning Equipment: Automatic, dry abrasive blast type, with vacuum recovery systems to control dust and collect surface abrasions.

B. Mechanical Cleaning Equipment: Automatic, dry shot blast type, self contained capable of recycling blast materials and collecting surface abrasions.

3.3 SURFACE PREPARATION

A. Mechanically clean concrete substrate and create surface profile in existing concrete substrate in accordance with ASTM D 4259.

1. Mechanically clean concrete substrate to remove surface and penetrating contaminates to produce a surface profile of ICRI CSP 3 in accordance with ICRI Technical Guideline No. 310.2.
2. Acceptable substrate surfaces will be free of laitance, oil, grease, flooring adhesive, paint, and other surface contaminates capable of affecting bond of specified floor finishes to concrete substrate.

B. Repair surface irregularities after cleaning.

1. Fill bugholes, spalls, cracks, deteriorated joints and other surface damage exposed or created as a result of substrate cleaning operations flush with adjacent surfaces to provide sound substrate for specified floor finish.

C. Dry broom or vacuum clean concrete substrates immediately before application of specified floor finishes in accordance with ASTM D 4258 to remove loose materials on substrate surface.

D. When field quality control report indicates portions are unsatisfactory, repeat process until field quality control report indicates there are no unsatisfactory portions remaining.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

1. Visual inspection of completed substrate preparation to verify contamination is removed.
2. Visual inspection of completed substrate preparation to verify surface profile matches ICRI CSP 3, using ICRI standard rubber mold for visual comparison.
3. Prepare field quality control report. Clearly indicate the locations, extents, and conditions of areas where surface preparation does not conform to specified profile and cleanliness. Document observed conditions with digital photographs.
4. Repeat inspections when additional surface preparation for unsatisfactory conditions indicated in the previous field quality control report.

3.5 PROTECTION

A. Protect prepared concrete substrates from contamination. Reclean substrates that are contaminated by construction operations prior to installation of specified floor finishes.

END OF SECTION 090511

SECTION 090512 - CONCRETE FLOOR MOISTURE CONTENT AND PH TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete moisture content testing using water vapor emission method.
2. Concrete moisture content testing using relative humidity method.
3. Concrete pH testing.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

B. Scheduling: Schedule work to permit concrete moisture testing to be completed minimum one week and maximum 3 weeks before floor coverings are installed.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Submit model and manufacturer for calcium chloride test kits.
2. Submit data indicating model, manufacturer, and calibration record for relative humidity measuring equipment.
3. Submit data for floor slab treatment products.

B. Shop Drawings:

1. Indicate test locations shown on building floor plan,

1.5 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

B. Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for concrete moisture acceptable limits.

C. Test Reports: Report test results in chart form.

1. Calcium Chloride Test Method: Indicate test dates, start/stop time, start/stop weight, weight gain in grams, water vapor emission rate, and pH levels.
2. Relative Humidity Test Method: Indicate test dates, time, depth of test well, in-situ temperature, relative humidity and pH levels.
3. Submit record of ambient air temperature, ambient relative humidity, and floor slab surface temperature when test sites are prepared, start of test, and end of test.
4. Indicate condition of building enclosure including position of operable windows and exterior doors when test sites are prepared, start of test, and end of test.
5. Submit transcript of datalogger.
6. Indicate operational status of HVAC systems maintaining environmental condition of spaces where tests are conducted when test sites are prepared, start of test, and end of test.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver calcium chloride test kits to Project site in manufacturer's original, sealed packaging.

B. Accept test kits on site. Inspect test kits for damage. Replace damaged test kits.

1.7 FIELD CONDITIONS

A. Ambient Conditions:

1. Do not perform concrete moisture testing until building is enclosed and HVAC system is operational.
2. Maintain building test areas at design operating conditions for minimum 48 hours before, during, and continuously after conducting testing.

PART 2 - PRODUCTS

2.1 CALCIUM CHLORIDE TEST KITS

A. Calcium Chloride Test Kit: Comply with ASTM F1869.

2.2 RELATIVE HUMIDITY TEST EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Vaisala www.vaisala.com.

B. Humidity and Temperature Probe and Meter: Comply with ASTM F2170.

2.3 pH TEST MATERIALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Micro Essential Laboratory www.microessentiallab.com.

B. pH Test Paper: Capable of indicating minimum 7.0 to 13 pH range.

C. pH Color Gage: Furnish pH test paper manufacturer's visual color gage to identify measured pH.

D. Water: Distilled or deionized.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify new concrete floors have cured minimum 28 days.

3.2 PREPARATION

A. When a building HVAC system is not operational and maintaining test areas at design operational conditions, install recording hygrometer or data logger in each separate test area to record ambient temperature and relative humidity beginning 48 hours before start of tests until completion of tests within each area.

B. Identify three moisture test sites for first 1,000 sf and one moisture test site for each additional 1,000 sf of floor area receiving floor covering on each separate floor slab.

1. Layout test site locations uniformly distributed throughout each test area.

C. Mechanically clean each test site to remove oils, laitance, curing compounds, adhesives, and other contaminates affecting water vapor emissions.

1. Remove cleaning residue.
2. Do not apply water or other liquid to floor slabs and test sites.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform concrete moisture tests and inspections and prepare test reports:

B. Acceptance Criteria:

1. Concrete floor slabs will be considered acceptable for installation of floor finishes when:

a. Calcium Chloride Test Result: 3 lb of water/1000 sf in 24 hours maximum moisture vapor transmission rate.
b. Relative Humidity Test Result: 75 percent maximum relative humidity.
c. pH Test Result: Within alkalinity range of 7.0 to 9.0.

2. When concrete floors do not meet acceptance criteria, obtain recommendations from floor finish manufacturers for remediation measures necessary to permit successful floor finish installation.

C. Concrete Moisture Testing – General

1. Conduct calcium chloride test and relative humidity test at each test site.

2. Conduct one pH test at each test site.

D. Calcium Chloride Testing:

1. Perform tests in accordance with ASTM F1869.

E. Relative Humidity Testing:

1. Perform tests in accordance with ASTM F2170.
2. Conduct relative humidity testing at the following depths:

   a. Slabs-On-Grade: Measure temperature and relative humidity at 40 percent of slab thickness measured from top surface.
   b. Elevated Slabs: Measure temperature and relative humidity at 20 percent of slab thickness measured from top surface.

3. Drill test hole at each test site to accommodate test sleeve.

   a. Hole Diameter: In accordance with test equipment manufacturer's instructions.
   b. Drilling Fluids: Not permitted.

4. Vacuum dust and debris from test hole.
5. Insert sleeve, to the full depth of test hole. Cap or plug sleeve to prevent test hole contamination.
6. Permit the test site to acclimate for minimum 72 hours before measuring relative humidity.
7. Remove sleeve plug and insert probe to bottom of test hole. Allow test probe to reach temperature equilibration with concrete slab.
8. Measure and record temperature and relative humidity at the test site.

F. pH Testing:

1. Place several drops of water onto the concrete surface to form a puddle approximately 1 inch in diameter.
2. Allow the water to set for approximately 60 seconds
3. After 60 seconds, dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading.
4. Record and report results.

END OF SECTION 090512

SECTION 092113 – PLASTER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Install cementitious plaster wall surface (stucco/parging) at all exposed, visible interior and exterior wall surfaces not finished by other means, with the exception of floor surfaces or surfaces explicitly indicated as receiving no finish.

B. Work Included: The Work of this Section includes, but is not limited to the following:
1. Interior plastering finish
2. Exterior plastering finish

C. Documents affecting work of this Section include, but are not necessarily limited to:
1. 079200 – JOINT SEALANTS
2. 092110 – GYPSUM BOARD ASSEMBLIES

1.3 SUBMITTALS

A. Submit for approval samples of all plaster applications, together with manufacturer's product specifications and installation instructions for each material, and include other data as may be required to show compliance with these specifications. Provide two (2) copies of any supporting literature.

B. Provide four (4) 1000mm x 1000mm samples of each type of plaster application, erected in place, showing quality of work; installation and finish. These samples when approved shall serve as a standard for all plaster work subsequently erected.

1.4 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver all manufactured materials in the original packages, containers, and bundles bearing the name of manufacturer and brand. Except as otherwise specified herein, the mixing, installation, and application of manufactured material shall be in strict accordance with the printed directions of the manufacturer.

B. The Contractor shall protect plaster, lath, and all cementations materials against dampness until used. Materials shall be stored off the ground, under cover, and away from sweating walls and other damp surfaces.

1.5 PROJECT CONDITIONS

A. A. Install cementations plaster wall surface (stucco/parging/rendering) as indicated on the drawings.

B. All materials shall be of high quality, obtained from manufacturer's to be approved by the Architect.

C. Temperature Requirements for Plaster: Do not apply plaster unless a uniform temperature of not less than 40 degress F (4.4 degrees C) has been maintained and continues to be maintained for not less than 7 days before plaster application, during plaster application, and not less than 7 days after plaster is dry.

D. Ventilation: Provide ventilation for the drying of plaster during and after application.

PART 2 - PRODUCTS

2.1 INTERIOR PLASTERING FINISH

A. Internal plaster to be 12mm. Dampen wall before applying a scud (rough) coat of 9mm thickness (1:4). Scarify first coat to ensure full bond to subsequent coat. Finish coat to be 3mm plaster skim. Plaster application to comply with Engineer's Specifications.

B. Internal areas to be plastered include: See finish schedule in Architectural Drawings.

2.2 EXTERIOR PLASTERING FINISH

A. Exterior plaster to be 12mm. Dampen wall before applying a scud (rough) coat of 9mm thickness (1:4). Scarify first coat to ensure full bond to subsequent coat. Finish coat to be 3mm plaster skim. Plaster application to comply with Engineer's Specifications.

B. External areas to be plastered include: All visible blockwork and cast-in-place surfaces at walls, ceilings, columns and elsewhere. See Exterior Elevations in Architectural Drawings.

2.3 PLASTER FINISHING

A. After confirming the preceding coat surface to be reasonably dry, finish coat of interior or exterior cement mortar shall be uniformly applied thereon free from blemishes and irregularities.

B. The work of steel trowel finish shall be started with wood float and finished with steel trowel. The work of brushing finish shall be done by brush after the work of steel trowel finish. The work of wooden float finishing shall be done by using only wood float.

C. All plastering to use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 3mm per 300mm. The edges of all plaster finishes to be continuous with finish plaster work specified elsewhere.

2.4 MIXES

A. Mixing of plaster shall be done in mechanical type mixers, except that hand mixing may be used when approved by the Owner.

B. Measurements shall be by volume or weight. Any caked or lumpy materials or material that has partially set shall not be used. Re-tempered plaster that has partially set shall not be used.

C. The Contractor shall clean the mixer of all set or hardened material before materials for a new batch are loaded. Mixing tools and equipment shall be kept clean.

D. Each batch shall be mixed separately. The mixing sequence and cycle of operations and time shall be in accordance with the material manufacturer's direction.

E. The mix: The method of measuring and mixing plaster shall be as laid down under Concrete work and the proportions and minimum thickness of finished plaster shall be in accordance with the following:

Item of Work	Mix	Minimum Thickness and Finish
Internal Plaster	1 part cement 4 parts sand	12mm finish in two coats to walls. Wood float finish unless otherwise specified.
External Render	1 part cement 4 parts sand	12mm finish in two coats to walls Wood float finish unless otherwise specified.

F. To obtain greater plasticity a small quantity of lime may be added to the mixes for external plastering at the Architect's discretion but in any case this is not to exceed ¼ part lime to 1 part cement. Plaster application to comply with Engineer's Specifications.

G. Preparation of surface to render: Irregularities in the surfaces to be plastered or rendered shall be filled with mortar, without lime, twenty four hours before plastering is commenced. Joints in brickwork, are to be well raked out before plastering to form a good key. Smooth concrete surfaces to be plastered shall be treated with an approved proprietary bonding agent or hacked to provide an adequate key for the plaster.

H. All surfaces to be plastered or rendered shall be clean and free from dust, loose mortar and all traces of salts.

I. All surfaces shall be thoroughly sprayed with water and all free water allowed to disappear before plaster is applied.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES FOR PLASTER

A. Irregularities in the surfaces to be plastered or rendered shall be filled with mortar, without lime, twenty four hours before plastering is commenced. Joints in brickwork, etc. are to be well raked out before plastering to form a good key. Smooth concrete surfaces to be plastered shall be treated with an approved proprietary bonding agent or hacked to provide an adequate key for the plaster.

B. All surfaces to be plastered or rendered shall be clean and free from dust, loose mortar and all traces of salts.

C. All surfaces shall be thoroughly sprayed with water and all free water allowed to disappear before plaster is applied.

D. As far as practical, plastering shall not be commenced until all mechanical and electrical services, conduits, pipes and fixtures have been installed.

E. Before plastering is commenced all junctions between differing materials require control joints. This shall apply where walls join columns and beams, particularly where flush and similar situations where cracks are likely to develop and as directed by the Architect. The joints shall consist of hot-dipped galvanized V Control Joint, ¼" with perforated flanges for wire attachment to adjacent surfaces.

F. Examination of surfaces: Before plaster is applied, the surfaces to be plastered shall be carefully examined whether there are any unsatisfactory conditions. Application of plaster shall not proceed until such unsatisfactory conditions have been corrected.

3.2 APPLICATION OF PLASTER AND RENDER

A. After preparation of the surfaces a key coat of cement slurry shall be applied to the wetted surface to be plastered. When this coat is dry the plaster coat shall be applied, by means of a trowel, between screeds laid, ruled and plumbed as necessary. This coat which shall be to the required thickness shall be allowed to set hard and then cured as described. Surfaces are to be finished with a wood or steel float to a smooth flat surface free from all marks.

B. Scratch Coat:
1. Cement and sand mortar shall be sufficiently rubbed in with float without leaving any depressions.
2. Scratch coat shall be properly roughened with such tools as metal combs.
3. Surface shall be cured more than three (3) days and the next coating shall be applied after thorough development of cracks over scratch coat surface. Dubbed out surface on concrete wall shall be cured more than one (1) week. Shortening of the curing time caused by weather conditions may be permitted in consult between Owner and Contractor.

C. Finish Coat:
1. After confirming the preceding coat surface to be reasonably dry, finish coat of cement mortar shall be uniformly applied thereon free from blemishes and irregularities.
2. The work of steel trowel finish shall be started with wood float and finished with steel trowel and the work of brushing finish shall be done by brush after the work of steel trowel finish. Wooden float finishing work shall be done by using only wood float.

D. Tyrolean Finish: Tyrolean finish shall be applied with an approved machine to give a finish of even texture and thickness. The sprayed finish shall be applied in two separate coats allowing time for drying between coats.

E. Tyrolean Finish: Application in one continuous operation to build up a thick layer will not be permitted. The total finished thickness of the two sprayed coats shall be not less than 6 mm. The sprayed finish shall not be applied until all repairs and making good to the undercoat are completed. Any plaster which adheres to pipes, doors, windows and the like shall be carefully removed before it has set. Curing shall take place after the application of the second coat. The finished surface shall be wither `rough textured' or `Pressed' finish as directed by the Architect. Where colored tyrolean is required this shall be obtained by the addition to the mix of an approved color pigment.

F. All plastering and rendering shall be executed in a neat workmanlike manner. All faces except circular work shall be true and flat and angles shall be straight and level or plumb. Plastering shall be neatly made good around pipes or fittings. Angles shall be rounded to 6 mm radius.

G. All tools, implements, vessels and surfaces shall be at all times kept scrupulously clean and strict precautions shall be taken to prevent the plaster or other materials from being contaminated by pieces of partially set material which would tend to retard or accelerate the setting time.

3.3 CURING OF PLASTER

A. The Contractor shall protect plaster from uneven or too rapid drying. After plaster has set hard, he shall provide and maintain free circulation of air to prevent sweat-outs.

B. Each coat of plaster is to be maintained in a moist condition for at least three days after it has developed enough strength not to be damaged by water.

3.4 ANGLE BEADS

A. Where required by the Architect, salient external angles of plastered walls shall be protected with galvanized mild steel angle beads complying with B.S. 1246 profile C3.

B. They shall be securely plugged, nailed or stapled as required at intervals not exceeding 450 mm at both edges.

3.5 PLASTER STOPS

A. Where shown on details, plasterwork shall be stopped against "Expamet" galvanized steel plaster stop, reference 565 which shall be securely nailed to walls in the positions indicated on the drawings.

B. Stops shall be neatly and closely fitted together at corners and it is important that they are secured to walls through all holes provided.

3.6 CEMENT AND SAND SCREEDS

A. Screeds shall be mixed and formed as described.

3.7 BONDING

A. Bonding compounds, etc. for use in applying plaster and similar finishes direct to surface without the use of backings or screeds are only to be used if approved by the Architect and are to be used strictly in accordance with the manufacturer's printed instructions.

END OF SECTION 092113

SECTION 092900 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum wallboard.
2. Non-load bearing steel framing.

1.3 SUBMITTALS

A. Product data: Provide for each material.

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of work.

1.4 QUALITY ASSURANCE

A. Standards: Design and install components and assemblies to comply with ASTM C 754, ASTM C 840, the AISI standard, the Gypsum Association reference standards, and 24 CFR.

B. Fire Resistance Characteristics: Assemblies/systems intended as fire rated assemblies are to be comprised of only those materials and construction methods identical to that tested for fire resistance by an independent testing agency per ASTM E 119, and found to provide the required rating.

1. Assemblies/systems are to withstand the required air pressure loads without failure while also maintaining an air/smoke tight seal.
2. Rating Designations: Such indications are usually those contained in the UL Directory.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 SUSPENSION SYSTEMS

A. Tie Wire: Galvanized, 1.57 mm diameter wire, or double strand of 1.21 mm diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, chemical anchor or postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 4 mm in diameter.

D. Flat Hangers: Steel sheet, 25 mm by 4 mm by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 1.34 mm and minimum 12 mm wide flanges.

1. Depth: 38 mm unless otherwise indicated.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 1.34 mm uncoated-steel thickness, with minimum 12 mm wide flanges, 19 mm deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.79 mm.
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 22 mm deep.

a. Minimum Base Metal Thickness: 0.45 mm.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; 640-C Drywall Furring System.
c. USG Corporation; Drywall Suspension System.
d. Architect approved equal.

2.2 INTERIOR GYPSUM PANELS

A. Comply with ASTM C 36. Select the type and core needed to produce the indicated and/or intended assembly/system. Provide material at full length or the maximum length available in order to minimize end-to-end butt joints. Never provide less than that thickness necessary to comply with ASTM C 840 for the intended application.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: As indicated.
2. Long Edges: Tapered and featured for prefilling.

C. Ceilings: Provide sag resistant with tapered long edges, for ceiling assemblies.

D. Moisture and Mold-Resistant Gypsum Board: Moisture and mold-resistant core and surfaces.

1. Complying with ASTM C 1396/C 1396M and ASTM C 630/C 630M as applicable to type of gypsum board indicated.

a. Thickness: As indicated.
b. Long Edges: Tapered.
c. Performance: Rating of 10 per ASTM D 3273.
d. Location: Wet areas.

E. Flexible Gypsum Wallboard: ASTM C 36, manufactured to bend to fit tight radii and to be more flexible than standard panels of the same thickness.

1. Thickness: As indicated.
2. Long Edges: Tapered.
3. Locations: As indicated. Apply in double layer at curved assemblies.

F. Liners: When indicated, provide panels manufactured as liners; must include moisture resistant paper faces.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
b. L-Bead: L-shaped; exposed long flange receives joint compound; use at exposed panel edges.
c. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges.

d. Expansion (control) joint: Use at locations as recommended by the panel manufacturer.
e. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.5 SEALANT

A. Acoustical: Provide a nonsag, paintable, nonstaining, latex complying with ASTM C 834. Product must be proven effective in reducing airborne sound transmission through joints and openings in building construction as demonstrated by successful testing per ASTM E 90.

1. Concealed Applications: In lieu of the latex, a nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber recommended for sealing interior joints to reduce transmission of airborne sound may be employed. Same performance standards apply.
2. Fire Resistance: Provide the flame spread and smoke developed ratings directed by regulation.

2.6 AUXILIARY MATERIALS

A. Provide only materials that comply with the referenced standards and the recommendations of the board manufacturer.

B. Laminated Adhesive: Provide materials that have a maximum VOC content of 50 g/L, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.84 to 2.84 mm thick.

D. Powder Actuated Fasteners: Provide corrosion resistant fasteners, that are appropriate (type, size, and material) for the intended application. Must be capable of sustaining the load conditions imposed without exceeding the allowable design stress of the track, the fastener, and/or the material being fastened.

1. Ceiling Applications: Must have the capability to sustain, without failure, a load equal to 10 times that imposed by the attaching construction, as determined by testing per ASTM E 1190.

a. Safety Factor: Revise to higher factor if directed by regulation.

E. Anchors: For attaching to concrete, provide resistant material. Must be capable of sustaining without failure a load equal to 5 times that imposed by the attaching construction, as determined by testing per ASTM E 488.

1. Safety Factor: Revise to higher factor if directed by regulation.

2.7 BLOCKING

A. Where blocking is indicated on the drawings or required for proper installation of a specified item, provide 20 Ga galvanized steel panels screw attached to the metal studs. The panel shall extend 2 studs beyond and 300 mm above and below all points of attachment indicated by the specified item's manufacturer.

B. Where wood blocking is called for on the Drawings, provide 50 mm by 152 mm fire-treated wood blocking between studs.

PART 3 - EXECUTION

3.1 STANDARDS

A. Comply with the performance requirements.

3.2 PREPARATION

A. Review the performance requirements, the applicable product reference standards and the applicable installation referenced standards. Establish and maintain those standards throughout the project.

B. Ambient Conditions: Maintain the following conditions:

1. Temperature: For nonadhesive attachment of board, maintain not less than 4 deg C. For adhesive attachment of board maintain not less than 10 deg C. In cold weather during joint finishing, temperatures within the building shall be maintained within the range of 13 to 21 degrees C and adequate ventilation shall be provided. Refer to USG folder J-75 for "Quality Drywall Finishing in All Kinds of Weather".

C. Materials: Review the materials being supported, and the scope/range of each system. Verify that the gage/spacing of the proposed framing and the quantity/nature of the proposed bracing/reinforcing/anchorage/supports complies with the performance requirements. Provide for the future needs as required by 24 CFR.

D. Anchors/Supports: Provide the inserts, anchorages, and intermediate/relieving supports necessary to complete the systems.

3.3 STEEL FRAMING

A. Provide the necessary supplementary framing for backing/support/reinforcement for both the gravity/pullout loads and the stresses generated by penetrations, fixtures, equipment services, heavy trim, grab bars, toilet accessories, hand rails, furnishings, system dead-load, etc, and/or the board's unique needs. Refer to USG's Gypsum Construction Handbook for guidelines.

B. Isolation (Structural): Prevent load transfer imposed via structural movement by providing slip/cushion type joints to avoid axial loading; include lateral support. Typical areas requiring attention:

1. Where the building structure abuts the ceiling perimeter or penetrates the ceiling.
2. Where framing abuts the structure, except at the floor.

C. Joints (Expansion and Control): Do not bridge; independently frame both sides.

3.4 STEEL FRAMING: CEILINGS

A. Inserts (Cast-In-Place): Extend through the forms. Do not support directly from permanent forms.

B. Deck Tabs And Roof Decks: Do not use for the attachment of hangers, unless the field engineer has certified that the attachment sub-system does comply with the performance requirements for ceiling fasteners.

C. Hangers: Secure from structural members only. Provide plumb, free from contact with insulation, etc, secured to appropriate anchor/fastener. Employ a manner that will not cause deterioration or failure due to age, corrosion, or temperature. Splay only where absolutely necessary to miss obstructions; offset the resulting horizontal forces by bracing, countersplaying, or other equally effective means. Provide a splayed hanger proposal that includes the manner of bracing, indicating where and why necessary, prior to proceeding.

D. Grid Suspension Systems: Provide a perimeter wall track/angle where the system meets any vertical surface. Mechanically join the main beam and the cross-furring members to each other; butt-cut to fit into wall track/angle.

E. Fire Rated Construction: Wire tie the furring channels to the supports in fire rated assemblies where occurs.

F. Bracing: Employ sway bracing when bracing is necessary except for exterior applications. Employ cross bracing at exteriors; provide adequate wind uplift resistance.

G. Obstructions: Where the width of ducts, or other construction, interferes with the proper spacings of the hangers, provide supplemental framing in the form of trapezes, etc. Size this supplemental framing to perform within the performance limits already established.

H. Tolerances: Furring members and suspension systems are to be level within 3 mm in 3657 mm as measured both lengthwise on each member and transversely between parallel members.

3.5 GYPSUM BOARD

A. For dry areas do not provide square edged panels, unless clearly indicated. Install wall panels vertically. Minimize the number of abutting end joints or avoid them entirely. If abutting end joints are necessary, stagger them not less than one framing member in alternate courses of board. Set panels the face side out and butt them together with light contact; provide no more than 1.58 mm of open space between panels – but do not force into place. Secure to all framing and fit neatly around ducts, pipes, conduits, etc.

1. Horizontal Exceptions: High walls, curved walls, and applications using tongue and groove boards are to be installed horizontally, unless rated construction requires otherwise.

B. Joints (Panel): Locate over supports, except in ceiling applications where intermediate framing or gypsum board back-blocking is provided behind end joints. Position adjoining panels so that tapered edges abut tapered edges, and field cut edges abut field cut edges and ends. Stagger vertical joints on opposite sides of the assembly. Provide no joints (other than control) at the corners of framed openings, and no end joints in the central area of a ceiling.

C. Joints (Control Joints and Expansion): Do not bridge those in the underlying construction. Provide to comply with the performance requirements, and where indicated. For the owner's review of appearance, submit the proposed locations of those that will be provided to comply with the performance requirements.

D. Steel Framing: Secure the panels so that the leading edge or end of each panel is attached to the open (unsupported) edges of the stud flanges first. Cover both faces of studs except at identified walls, which are to be braced internally. Inaccessible areas, not requiring sound, fire, air, smoke, etc. ratings may be covered with scraps not less than 0.7432 sq/m area.

E. Isolation: Provide a 6 mm to 9 mm wide gap at structural abutments (except floors), and trim the edge with bead where exposed. Seal the gap between the panels and the abutting surfaces.

F. Fire Rated Assemblies: Include supplementary fire protection and firestopping at all penetrations.

G. Irregularities: Where systems intersect open coffers, or joists, beams, etc. projecting below the underside of slabs and decks, cut the panels to fit the profile formed by the coffers, joists, etc. Provide a 6 mm to 12 mm wide gap for sealant.

3.6 GYPSUM BOARD APPLICATION

A. Single Layer: Install ceiling panels prior to wall/partition panels. Install ceiling panels and at right angles to the framing, unless otherwise indicated.

B. Double Layer: Install the base layer prior to applying the base layer on the wall/partition; apply face layers in same sequence. Offset the joints of the face layer no less than 406 mm from parallel base layer joints. Apply base layer at right angles to framing members unless otherwise indicated.

C. Direct Bonding: Provide temporarily braces/fasteners until the adhesive has set.

D. Where panels abut other types of panels, shim surfaces to produce a uniform plane across all surfaces.

3.7 TRIM

A. Secure back flanges of trim to the framing with the same fasteners used to fasten the board to the studs.

B. Corner Bead: Provide at outside corners.

C. Edge Trim: Provide LC or L bead on the edge of exposed panels. Trim to have a face flange formed to receive joint compound.

1. LC Bead: Employ where the panels are tightly abutted to other construction, and the back flange can be attached to framing or supporting substrate.
2. L Bead: Employ where the trim can only be installed after the panels.
3. U Bead: Employ only if indicated; use is restricted.

D. Control Joint Trim: Provide at control joints.

3.8 GYPSUM BOARD ASSEMBLIES

A. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.
3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

a. Exception: Provide Level 5 finish at walls receiving a latex semi-gloss paint finish. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply a dual-purpose vinyl acrylic latex-based primer-surfacer over entire surface.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic tile for:

a. Toilet room walls.
b. Exterior walls.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 304 mm square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product, signed by product manufacturer.

B. Material Test Reports: For each tile-setting and -grouting product.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile:

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Joint sealants.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: “Crossville”; Daltile; or Architect approved equal.

B. Ceramic Wall Tile (Toilet Rooms): ANSI A137.1.

1. Style: Subway tile as approved by Architect.

2. Manufacturer: Local sourced polished tile.
3. Size: 200 mm by 200 mm by minimum 6 mm thick.
4. Color: As selected by Architect.

C. Glazed Ceramic Wall Tile (Exterior walls): ANSI A137.1.

1. Style: Subway tile as approved by Architect.
2. Manufacturer: Local sourced rile.
3. Size: 200 mm by 200 mm by minimum 6 mm thick.
4. Color: As selected by Architect.

D. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows but not limited to, selected from manufacturer's standard shapes:

1. Caps, external corners, internal corners, cove, transitions.

E. Frost Resistance: Resistant per ASTM C1026.

2.2 PRODUCTS, GENERAL

A. ANSI Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 SETTING MATERIALS

A. Latex-Portland Cement Mortar: ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following for project application:

a. Custom Building Products; Mega Lite.
b. Laticrete International, Inc.; 220 Marble Granite.
c. MAPEI Corporation; Kerabond T / Keralastic.
d. Architect approved equal.

2. Wall Applications: Provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.4 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color as selected by Architect.

1. Bases of Design Manufacturer: Subject to compliance with requirements, provide products by Laticrete International, Inc.: As recommended by Manufacturer or comparable product by Architect approved equal.
2. Grout Color: As selected by Architect from manufacturer's full range.
3. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

B. Polymer-Modified Tile Grout: ANSI A118.7.

1. Bases of Design Manufacturer: Subject to compliance with requirements, provide products by Laticrete International, Inc.: As recommended by Manufacturer or comparable product by the following:

a. Architect approved equal.

2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix. Colors: As selected from manufacturers standards to match tile being grouted.

2.5 ELASTOMERIC SEALANTS

A. As specified in Section 079200 "Joint Sealants."

1. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Grout Sealer: Grout manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout or tile.

D. Transition Strips: Provide metal transitions as directed by the Architect unless indicate otherwise.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.2 TILE INSTALLATION

A. Comply with ISO/TR 17870-1:2015.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Install tile with the joint widths indicated on the Drawings.

F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093000

SECTION 095426 - SUSPENDED WOOD CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions 01 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:

1. Suspended wood ceiling panels.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of wood ceiling unit and suspension system required.

B. Delegated Design: Engage a qualified professional engineer to design supports and attachment system for suspended ceiling systems, signed and sealed by the responsible design professional.

1. Shop Drawings: Layout and details of wood ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide wood panel units and grid components by a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing wood ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle wood ceiling units carefully to avoid chipping edges or damaged units in any way.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient

temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Abnormal conditions include exposure to moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.

1.7 WARRANTY

A. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Wood Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
2. Suspension System Components: Furnish quantity of each suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wood Ceiling Panels:

1. Fabricated from Hevea wood (“Rubberwood”) panels clear hardwood lumber, selected for compatible grain and color.
2. Size: Minimum 19 mm thick by 1219 mm by 2438 mm.
3. Weight: Minimum 19.53 kilograms per square meters.

2.2 SUSPENSION SYSTEMS

A. Suspension Hanger Brackets: Metal hanger brackets attached to supporting suspension frame and wood panel.

B. Supporting Suspension Frame: 40 mm by 40 mm wood attached to perimeter, back of suspended wood panels.

C. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 1.57 mm diameter wire, or double strand of 1.21 mm diameter wire.

D. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that

imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, chemical anchor or postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

E. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 4.12 mm in diameter.

F. Flat Hangers: Steel sheet, 25 by 5 mm by length indicated.

G. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 1.34 mm and minimum 13 mm wide flanges.

1. Depth: 38 mm.

H. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 1.34-mm uncoated-steel thickness, with minimum 13-mm wide flanges, 19 mm deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.84 mm.
b. Depth: 64 mm.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 22 mm deep.

a. Minimum Base-Metal Thickness: 0.84 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including cast-in anchors, and framing, for compliance with requirements and other conditions affecting performance of the Work.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of wood units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

C. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

A. Installing suspension systems

1. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types and other assembly components indicated.
2. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
3. Suspend hangers from building structure as follows:

    a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    b. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
    c. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    d. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
    e. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
    f. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
    g. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
    h. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
    i. Do not connect or suspend steel framing from ducts, pipes, or conduit.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of wood ceilings, including trim, edge moldings. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095426

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resinous flooring systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

C. Product Schedule: For resinous flooring. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: For each resinous flooring component, from manufacturer.

C. Material Test Reports: For each resinous flooring system.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 4.45 square meters selected by Architect.

    a. Include 1200 mm length of integral cove base with inside and outside corner.

2. Simulate finished lighting conditions for Architect's review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Subject to compliance with requirements, provide products by Laticrete: Spartacote Flex Pure Clinical Plus or Architect approved equivalent.

2.2 RESINOUS FLOORING

A. Resinous Flooring: Abrasion-, impact and chemical-resistant, resin-based, fluid applied floor surfacing.

B. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Adhesion: 400+ concrete fracture per ASTM D 4541.
2. Tensile Strength: 4,500-5,000 per ASTM D 638.
3. Impact Direct/Reverse: 160/160 per ASTM D 2794 Inch Pounds.
4. Abrasion Resistance: 22-28 maximum weight loss per ASTM D 4060.
5. Flammability: Self-extinguishing per ASTM D 635.
6. Hardness: 84, Shore D per ASTM D 2240.

C. System Chemical Resistance: As per manufacturer's chemical resistance chart.

D. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Manufacturer's standard wearing surface.
3. Overall System Thickness: See Drawings.

E. Body Coats:

1. Resin: 100% solid epoxy.
2. Formulation Description: Manufacturer's standard formulation.
3. Application Method: Provide application method required by system and application.

a. Thickness of Coats: As recommended by manufacturer for selected system.

4. Aggregates: Manufacturer's standard.

F. Topcoat: Sealing or finish coats.

1. Resin: Epoxy.
2. Formulation Description: Manufacturer's standard formulation.

G. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Flammability: Self-extinguishing per ASTM D 635.

2.3 ACCESSORIES

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.

B. Waterproofing Membrane: Basis of Design, Laticrete; MVIS Air & Water Barrier or Architect approved equivalent.

C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

D. Moisture Mitigation Membrane: Provide Moisture Vapor Barrier for concrete slabs exhibiting elevated moisture vapor emission rates per manufacturer's recommendations.

1. Formulation Description: 100% Solids Chemically Enhanced Epoxy.
2. Exceeds ASTM F3010.
3. Single coat at 12 Mils Thick.
4. Alkalinity Resistance up to 14pH per ASTM D1308.

F. Antimicrobial Protection: Manufacturer's recommended resinous coating for protection from degradation caused by microbial growth.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 150 mm high.

E. Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

F. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.

G. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.

H. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Core Sampling: At the direction of Architect and at locations designated by Architect, take one core sample per 9 square meters of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.

B. Material Sampling: Architect may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.

1. Contractor to engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Field painting of exposed interior items and surfaces.
2. Field painting of exposed exterior items and surfaces.
3. Surface preparation, priming, and finish coats of painting.

B. Work Not Included:

1. Pre-Finished Items: Do not include painting when shop or factory finishing is specified for such items as roof panels, or mechanical or electrical equipment.
2. Concealed Surfaces: Painting is not required on surfaces in concealed or generally inaccessible areas such as pipe spaces and duct shafts.
3. Operating Parts: Moving parts of mechanical and electrical devices, motor and fan shafts will not require painting.
4. Labels: Do not paint over any code-required labels or any equipment identification, performance rating, name, or nomenclature plates.

1.3 SUBMITTALS

A. Product Data: Submit product data that verify or are required to ensure compliance with the Contract Documents, to include technical information, product data, specifications, shop drawings, samples, calculations, product test reports, etc.:

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
3. Certification by the manufacturer that products supplied comply with local regulations controlling the use of volatile organic compounds (VOCs).

B. Samples: Prior to painting, submit samples for Architect review of each required color and texture. Identify materials used on samples. Samples shall have each coat of paint exposed the same amount and tinted slightly different than other coats.

1. On 304 mm by 304 mm hardboard, submit three (3) samples of each color, material and texture, until sheen, color, and texture are acceptable.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required on the Project. Duplicate finish of approved prepared samples.

1. The Architect will select one surface to represent surfaces and conditions for each type of coating and substrate to be painted.
2. After appropriate lighting has been determined, apply coatings to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
3. Final approval of colors will be from job-applied samples.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area based on manufacturer's recommendations. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily to avoid fire risks.

1.6 PROJECT CONDITIONS

A. Advise manufacturers that the paints, primers, varnishes, and special coatings are to be used in a hot, humid, salt laden atmosphere in tropical climatic conditions characterized by high humidity, rainfall, and fungal growth, and obtain their guarantee of the suitability of materials supplied. This guarantee is required to be submitted to the Architect or Owner.

B. Paint shall be resistant to high moisture content, alkalinity, cracks and erosion, through weathering; shall be suitable for tropical climatic conditions characterized by high humidity, rainfall and fungal growth.

C. Do not apply paint in rain, fog or mist, or when relative humidity exceeds manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OR APPROVED EQUALS

A. Interior and Exterior Paints and Coatings: Provide first quality products as manufactured by one of the following manufacturers that meet or exceed specified requirements:

1. Benjamin Moore and Co.
2. The Sherwin-Williams Company.
3. PPG Paints.
4. Architect approved equal.

B. Materials used shall be best grade products of their respective kinds. The Painting Schedule is based on products from the above-named manufacturers. These are specified to establish a standard of quality and kind of material desired. Provide these products, or equals as approved by the Architect or Owner.

C. Note: If substitutes are proposed, submit complete schedule showing materials specified and equivalent materials proposed as substitutes. Provide complete manufacturer’s product data on proposed materials. Substitutes must be approved by the Architect or Owner before commitment for materials is made.

2.2 PAINT MATERIALS, GENERALS

A. Material Quality: Provide manufacturer’s best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer’s product identification will not be acceptable.

1. Compatibility: Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Volatile Organic Materials: Provide paint and coating products to comply with applicable environmental regulations and local authorities.
3. Undercoaters: Provide undercoaters recommended by the finish coating manufacturer for suitability with the substrate and compatibility with finish coats.
4. Color Pigments: Pure, non-fading, to suit substrates and service.

    a. Lead content in pigment, if any, is limited to contain not more than 0.5% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not be painted. Provide surface-applied protection before surface preparation and painting if removal is impractical or impossible.

C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 7/NACE No. 4.
2. SSPC-SP 11.
3. SSPC-SP 6/NACE No. 3.
4. SSPC-SP 10/NACE No. 2.
5. SSPC-SP 5/NACE No. 1.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Aluminum Substrates: Remove loose surface oxidation.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Cleaning: Before applying paint or other surface treatments, remove all dirt and foreign matter, grease and oil. Clean and prepare surfaces to be painted according to manufacturer’s written instructions for each particular substrate condition and as specified.

1. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated, remove oil, grease, dirt, loose mill scale, and other foreign substrates.
2. Cementitious Materials: Prepare concrete and concrete masonry block surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen, as required, to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
3. Interior Gypsum Board; Ceiling Locations: Sand joints and patches until smooth. Remove efflorescence, chalk, dust, dirt, grease, and oils.

3.2 APPLICATION

A. General: Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

B. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer’s written instructions, sand between applications.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer’s written instructions.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Prime coats: Before applying finish coast, apply a prime coat of material, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others.

F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed at exterior locations and in equipment rooms:

   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   i. Stair signs.
   j. Rated wall signs.

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.3 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINT SCHEDULE

A. Basis of Design Products: Provide the following exterior paint systems for substrates indicated on the Drawings and Finish Schedules.

B. Metal (Ferrous and Non-ferrous Metals):

1. Acrylic Finish System:

a. Primer coat: Anti-corrosive zinc-rich paint primer. Refer to manufacturer's recommendations for number of coats and surface preparation.
b. Finish coats: Aliphatic acrylic polyurethane. Refer to manufacturer's recommendations for number of coats for required application.
c. Colors as approved by Architect.

C. Cementitious Materials (Concrete, Plaster, and Concrete Masonry Units):

1. Three Coat Acrylic Latex Finish.

a. Primer coat: Latex concrete and masonry primer, one coat.
b. Finish coats: Acrylic Latex, semi-gloss Finish, 2 finish coats. Color approved by Architect.

3.6 INTERIOR PAINT SCHEDULE

A. Basis of Design Products: provide the following interior paint systems for substrates indicated on the Drawings and Finish Schedules.

B. Interior Gypsum Board and Ceilings:

1. Vinyl Acrylic Latex Flat Finish: 2 finish coats over a primer.
2. Primer Coat: Latex-based interior primer.

C. Metal (Ferrous and Non-ferrous Metals):

1. Acrylic Finish System:

a. Primer coat: Anti-corrosive zinc-rich paint primer. Refer to manufacturer's recommendations for number of coats and surface preparation.
b. Finish coats: Aliphatic acrylic polyurethane. Refer to manufacturer's recommendations for number of coats for required application.
c. Colors as approved by Architect.

D. Cementitious Materials (Concrete, Plaster, and Concrete Masonry Units):

1. Primer coat: Latex concrete and masonry primer, one coat.
2. Finish coats: Acrylic Latex, semi-gloss Finish, 2 finish coats.
3. Colors as approved by Architect.

END OF SECTION 099100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results Includes:

1. Code-required signage.
2. Panel signs for room identification.
3. Dimensional characters of cast aluminum.
4. Directional building interior signage.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording and lettering layout.
2. Provide sign schedule with interior elevations indicating mounting location for each sign mounted on permanent construction. Show proposed mounting method and height. Include interior elevations showing each sign location relative to adjacent door, frame or other construction.

C. Samples for Verification: For each type of sign, include the following Samples to verify color selected:

1. Panel Signs: Full-size Samples of each type of sign required.
2. Dimensional Characters: Full-size Samples of each type of dimensional character (letter and number) required. Show character style, material, finish, and method of attachment.
3. Show graphic style, and colors and finishes of letters, numbers, and other graphic devices.
4. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
5. Approved samples will be returned for installation into Project.

D. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the International Building Code accessibility regulations and requirements and with code provisions as adopted by authorities having jurisdiction.

B. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

C. Source Limitations: Obtain each sign type through one source from a single manufacturer.

1.4 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.5 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

PART 2 - PRODUCTS

A. Signage Products: Signage with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASI Sign Systems, Inc.
b. Best Sign Systems, Inc.
c. InPro Corporation.
d. Mohawk Sign Systems.
e. Seton Identification Products.
f. Signarama.
g. Architect approved equal.

2.2 MATERIALS

A. Cast-Acrylic Sheet: Cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet; sizes and thicknesses indicated; minimum flexural strength of 16,000 psi when tested according to ASTM D 790; minimum allowable continuous service temperature of 80 degrees C.

1. Clear sheet: Colorless transparent sheet, matte finish, with light transmittance of 92 percent when tested per ASTM D 1003.
2. Colored opaque acrylic sheet.

B. Colored Coatings for Acrylic Sheet: Use coatings, inks and paints for copy and background colors that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

1. Custom match background colors indicated on finish legend, or if not indicated, match Architect's samples.
2. For reverse engraved text color, match embedded text color.

C. Vinyl Text Inserts: White stock as recommended by sign manufacturer with black text for changeable text fields. Text to match Owner's requirements, as marked on submittals.

D. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 5005-H15.

E. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of alloy 6063-T5.

2.3 PANEL SIGNS

A. General: Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1.58 mm measured diagonally.
2. Material: Acrylic sheet.

B. Graphic Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.

1. Signs that designate permanent rooms and spaces and signs that provide direction to or information about functional spaces (and other signs required to comply) shall comply with the ADA.

C. Frameless Panel Signs: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:

1. Edge Condition: Square edge.
2. Corner Condition: Square.
3. Panel thickness: 3 mm.
4. Panel finish: Matte.
5. Letter Style: As selected by Architect.

D. Backing: Permanently laminate face panels to backing sheets of material and thickness indicated using the manufacturer's standard process where required by fabricating process or mounting methods, or where otherwise indicated.

E. Changeable Message Units: Provide units with slots for changeable messages. Form slots by using opaque acrylic spacer sheets and backing sheets.

1. Omit background color of clear acrylic face panel at location of changeable message field.
2. Spacer Sheet: Solid opaque acrylic in black or white as selected by Architect.
3. Backer Sheet: Color matched to background color either by back painting clear sheet or solid color matched acrylic.
4. Fabricate face and backing sheet from 1.58 mm thick with spacer not less than 0.508 mm thick. Size spacer to accommodate laser bond paper up to cover stock thickness. Bond all 3 layers together seamlessly.

F. Panel Sign Copy Process and Materials: Provide fused embedded copy for text, graphics and braille required to comply with the ADA. Provide reverse-engraved graphics and text for graphics not required to comply with ADA.

1. Engraving: Form recesses by machine-engraving letters, numbers, symbols, and other graphic devices into sign panel on the face indicated to produce precisely formed copy, incised to uniform depth. Use high-speed cutters mechanically linked to master templates in a pantographic system or equivalent process capable of producing characters of the style indicated with sharply formed edges.

   a. Face-Engraved Copy for Embedded Text: Engrave copy to produce a minimum indentation depth of 0.793 mm.

      1) Embed raised copy as specified below, apply opaque background color coating to back face of acrylic sheet.

   b. Raster for Braille: Accurately drill indentations to receive braille raster balls so raster balls protrude as required from face.
   c. Reverse Engraved Copy: Engrave as above on reverse side of panel.

      1) Clear acrylic sheet: Fill engraved copy with enamel. Apply opaque background color coating to the back face of acrylic sheet.

2. Raised Copy: Machine-cut copy characters to fit recesses from white matte-finished opaque acrylic sheet and chemically weld into the acrylic sheet recesses forming embedded text sign panel face. Produce precisely formed characters with cut edges free from burrs and cut marks.

   a. Raised copy thickness: 1.58 mm.
   b. Form braille by fusing clear raster balls to drilled holes.

G. Provide one vinyl insert with text for each changeable text field.

2.4 DIMENSIONAL CHARACTERS

A. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Cast Characters for Interiors: Waterjet cut characters from solid plate of thickness and metal indicated. Produce precisely cut characters with square cut, smooth sanded edges. Comply with requirements indicated for finish, style, and size.

1. Material: Aluminum.
2. Thickness: Minimum 9.52 mm.
3. Logo Designs: Match designs on referenced attachments.
4. Character Style: As indicated on Drawings.
5. Letter Height: As indicated on Drawings.
6. Finish: Prefinished Organic Coating.

C. Cast Characters for Exterior Building Signs: Form individual letters and numbers by casting. Produce characters with smooth flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.

1. Material: Aluminum.
2. Character Style: As selected by Architect.
3. Letter Height: As indicated on the drawings.
4. Finish: Prefinished Organic Coating.

2.5 ACCESSORIES

A. Mounting Methods for Panel Signs: Use silicone adhesive fabricated from materials that are not corrosive to sign material and mounting surface.

B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.6 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

D. High-Performance Organic Finish (2-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color: As selected by the Architect from the manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:

1. Silicone-Adhesive Mounting: Use liquid-silicone adhesive recommended in writing by sign manufacturer to attach signs to irregular, porous, or vinyl-covered surfaces. Use double-

sided vinyl tape where recommended in writing by sign manufacturer to hold sign in place until adhesive has fully cured.

C. Glass-Mounted Panel Signs: Where panel signs are mounted on glass, use double-sided adhesive tape recommended by sign manufacturer. Provide matching plate on opposite side of glass to conceal mounting materials, aligned with sign and applied with double-sided tape, using blank panel of same material and color as sign panel unless otherwise indicated.

1. Where blank panel is located on exterior of building, provide 1.27 mm thick aluminum sheet of size and shape matching sign panel, finished to match adjacent aluminum framing.

D. Dimensional Characters: Mount characters using standard fastening methods recommended in writing by manufacturer for character form, type of mounting, projection distance from wall, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

3.3 GENERAL ROOM NAME AND IDENTIFICATION SIGN SCHEDULE

A. Toilet Room Signs: Pictogram, accessibility symbol, text, and Braille for “Men” and “Women.”
1. Install at each public toilet room door.

B. Stair Entry Signs: Pictogram, text, and Braille for “Exit Stair.”
1. Install in corridor at each stair tower entry door.

C. Elevator Signs:Pictogram, text, and Braille for “Elevator.”
1. Install in corridor at each elevator call station.

D. Elevator Lobby Signs: Pictogram, text, and Braille for “In Case of Fire do not use elevator, use stairway for exit.”
1. Install in corridor at elevator wall.

E. Elevator Jamb Floor Level Signs: Text, and Braille for floor number.
1. Install on each elevator jamb at each elevator lobby.

F. Room Identification Signs: Text, and Braille for Room Name and Room Number at each permanent room.

3.4 GENERAL INFORMATIONAL SIGN SCHEDULE:

A. Accessible Entrance Signs: Pictogram and the following text “Barrier Free Entrance” with directions to nearest accessible entrance.
1. Install at each accessible entrance when all entrances are not accessible.

B. Directions to Accessible Entrance Signs: Pictogram and the following text “For barrier free entrance use.” with directions to nearest accessible entrance.
1. Install at each nonaccessible entrance.

C. Use Stair Signs: Pictogram and the following text “In case of fire, do not use elevator. Use stairs.”
   1. Install at each elevator lobby adjacent to elevator hall call station.

D. No Smoking Signs: Pictogram and the following text “No Smoking.”
   1. Install at each elevator lobby and each building entry.

E. Drinking Fountain: Pictogram and Braille for “Water Fountain.”
   1. Install adjacent to each drinking fountain.

F. Stair Landing Signs: Text for “You are on level X, Y to Exit.” Where X is the floor number for the current landing and Y is the number of floors remaining to reach the exit discharge to grade.
   1. Install inside stair towers at each floor landing.

G. Occupancy Limit Signs: Text “Maximum Occupancy xxx Persons;” where “xxx” is the number of people permitted in each room.
   1. Install each assembly occupancy space.

H. High Voltage Equipment Signs: Text “High Voltage Equipment."
   1. Install each door leading to rooms with high voltage equipment.

I. Sprinkler Control Valve Signs: Text “Sprinkler Control Valve."
   1. Install each door leading to rooms containing sprinkler control valves.

END OF SECTION 101400

SECTION 102113 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures, entrance screens and urinal screens.

B. Coordination:

1. Pilasters shall be securely and rigidly fastened to structural steel or pre-cast concrete supporting member in ceiling by means of two heavy hanging studs permitting vertical adjustment between bottom of supporting member and finished ceiling line. Heavy hanging studs to be attached to pilasters by means of a heavy duty, minimum 10mm thick mounting bracket. The ceiling fastening shall be concealed and protected by a minimum 102 mm high stainless steel sleeve pilaster shoe. Ceiling hung partitions will be additionally stabilized by means of a 76 mm stabilizer mounted 2134 mm from the finished floor continuous around the interior of the stall.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, ceiling and wall attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains where occur.
5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 152 mm square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.

1. Door Hinges: five hinge(s) with associated fasteners.
2. Latch and Keeper: five latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: five bumper(s) with associated fasteners.
4. Door Pull: five door pull(s) with associated fasteners.
5. Fasteners: Ten fasteners of each size and type.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with International Building Code and Local Accessibility Standards and Guidelines.

2.2 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide Scranton Products Hiny Hiders solid partitions or comparable product by one of the following:

1. Metpar Corporation.

2. Bradley Corporation.
3. Architect approved equal.

2.3 SOLID-PLASTIC TOILET COMPARTMENTS

A. Materials: Solid, high-density polyethylene (HDPE) panel materials.

B. Toilet-Enclosure Style: Ceiling hung partitions.

1. Door and panels shall be 1397 mm high and mounted at 355 mm above the finish floor.

C. Door, Panel, Screen, Pilaster Component Construction: Not less than 25 mm thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

1. Pilasters: Mounted ceiling anchored.
2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: As selected by Architect from manufacturer's full range.

D. Pilaster Shoes: Manufacturer's standard design; stainless steel.

1. Polymer Color and Pattern: As selected by Architect from manufacturer's full range.

E. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets; stainless steel.

F. Entrance-Screen Style: Wall hung, where occur.

G. Urinal-Screen Style: Wall hung.

2.4 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Continuous.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with vandal-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FINISH

A. Doors, panels, and pilasters shall be certified CLASS B polyethylene or 100% post-consumer recycled polyethylene with uniform color throughout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 12.7 mm.
b. Panels and Walls: 25 mm.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 44 mm into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 50 mm into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102123 - CUBICLE CURTAINS AND TRACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cubicle curtains, tracks, carriers and shower curtains.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include durability, laundry temperature limits, fade resistance, applied curtain treatment, and fire-test-response characteristics for each type of curtain fabric indicated.
2. Include data for each type of track.

B. Shop Drawings:

1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
2. Include details on blocking above ceiling.

C. Samples: For each exposed product and for each color and texture specified, 254 mm in size.

D. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:

1. Curtain Fabric: 254 mm square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
2. Mesh Top: Not less than 254 mm square.
3. Curtain Track: Not less than 254 mm long.
4. Curtain Carrier: Full-size unit.

E. Curtain and Track Schedule: Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed[for each size indicated, but no fewer than 10 units.
2. Curtains: Full-size units equal to 10 percent of amount installed for each size indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical cubicle, complete with track, curtain as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Curtains: Provide curtain fabrics with the following characteristics:

1. Launderable to a temperature of not less than 71 deg C.
2. Flame resistant and identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Construction Specialties, Inc.
2. InPro Corporation (IPC).
3. A. R. Nelson Co.
4. Architect approved equal.

2.3 CURTAIN SUPPORT SYSTEMS

A. Extruded-Aluminum Curtain Track: Not less than 16 mm wide by 13 mm high with manufacturer's standard wall thickness.

1. Curved Track: Factory-fabricated, 305-mm radius bends.
2. Finish: Clear anodized.

B. PVC Curtain Track: Not less than 32 mm wide by 24 mm high.

1. Curved Track: Factory-fabricated, 305 mm radius bends.

C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

1. Suspended-Track Support: Not less than 22.2 mm OD tube.
2. End Stop: Nonremovable.
3. Switch Unit: Shuttle and coupling device for rerouting and securing cubicle curtain, with pull chain for switching track.

D. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel aluminum hook.

E. Breakaway Curtain Carriers: One-piece nylon breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than 22.2 N.

F. Exposed Fasteners: Stainless steel.

G. Concealed Fasteners: Stainless steel.

2.4 CURTAINS

A. Cubicle and Dressing-Area Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.

1. Pattern: As selected by Architect from manufacturer's full range.
2. Color: As selected by Architect from manufacturer's full range.
3. Length: 1727 mm.

B. Shower Curtain Fabric: Curtain manufacturer's standard, polyester-reinforced vinyl fabric; flame resistant, stain resistant, and antimicrobial.

1. Pattern: As selected by Architect from manufacturer's full range.
2. Color: As selected by Architect from manufacturer's full range.

C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 152 mm o.c.; machined into top hem.

D. Mesh Top: Not less than 508 mm high mesh top of No. 50 nylon mesh.

E. Beaded-Chain Curtain Drop: 305 mm long; nickel-plated steel with aluminum hook.

F. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.5 CURTAIN FABRICATION

A. Fabricate curtains as follows:

1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 305 mm added fullness.
2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor as follows:

a. Cubicle Curtains: 305 mm.
b. Dressing-Area Curtains: 152 mm.
c. Shower Curtains: 13 mm.

3. Top Hem: Not less than 25.4 mm and not more than 38 mm wide, triple thickness, reinforced with integral web, and double lockstitched.
4. Mesh Top: Top hem of mesh not less than 25.4 mm and not more than 38 mm wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 13-mm triple thickness, top hem of curtain fabric.

B. Vertical Seams: Not less than 13 mm wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install tracks level and plumb, according to manufacturer's written instructions.

B. Up to 6.0 m in length, provide track fabricated from single, continuous length.

1. Curtain Track Mounting: As indicated on Drawings.

C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:

1. Mechanically fasten directly to bottom of concrete deck with post-installed anchors.
2. Mechanically fasten directly to finished ceiling with toggle bolts.
3. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
4. Mechanically fasten to suspended ceiling grid with screws.
5. Attach track to suspended ceiling grid with manufacturer's proprietary clip.

D. Suspended-Track Mounting: Install track with manufacturer's standard tubular aluminum suspended supports at intervals and with fasteners recommended by manufacturer. Fasten supports to structure. Provide supports at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.

E. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

F. Curtain Carriers: Provide curtain carriers adequate for 152 mm spacing along full length of curtain plus an additional carrier.

G. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

END OF SECTION 102123

SECTION 102513 - PATIENT BED SERVICE WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Patient bed headwall system.
2. Medical gas outlet.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Indicate details for anchoring patient bed service walls to permanent building construction including locations of blocking and other supports.
2. Indicate locations and types of service fittings together with associated service supply connection required.
3. Indicate gas connections, electrical connections, and locations of access panels.
4. Include roughing-in information for mechanical, plumbing, and electrical connections.
5. Show adjacent walls, doors, windows, other building components, casework, and other medical equipment. Indicate clearances from above items.
6. Include layout of patient bed service walls in relation to lighting fixtures and air-conditioning registers and grilles.
7. Include coordinated dimensions for medical equipment specified in other Sections.

C. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For patient headwall to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of headwall manufacturer for installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A qualified manufacturer with minimum five years documented experience manufacturing specified products.

C. Source Limitations: Obtain all headwall products through one source from a single manufacturer.

D. Regulatory Requirements: Fabricate and label patient headwall to comply with UL listing for electrical components and local requirements for distribution of services contained within headwall.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify installation dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for lateral support of patient bed service walls.

B. Coordinate installation of patient bed service walls with and gas line, communications, and electrical work.

PART 2 - PRODUCTS

2.1 MODULAR PATIENT HEADWALL

A. Modular Patient Headwall: Factory fabricated, wired, and piped headwall assembly extending from 304 mm above finished floor to ceiling unless indicated otherwise, width as indicated.

1. Basis of Design Manufacturer: Amico Corporation; Majestic Series Recessed Single Tier Headwall or Architect approved equal.

B. Materials:

1. Wiring: pre-wire with service connections. Comply with UL requirements.
2. Enclosure shall be constructed of extruded, anodized aluminum alloy back boxes to provide a modular unit with accessory rails for equipment management.
3. Headwall shall be equipped with a frame assembly constructed of structural stud and track metal. Frame being a support for the medical gas piping and facilitates a single point connection.
4. Headwall system shall have integrated raceways and a single area connection for electrical wiring for each type of power (critical, normal and low voltage/communication).
5. Fascia panels shall be removable for access for easy installation and maintenance of headwall services.
6. Accessory Rails: Two (2) horizontal accessory channels, anodized aluminum and integrated into the removable front assembly.

7. Laminated Fascia: Aluminum strips with High pressure laminate (HPL), color and pattern selection by Architect.
8. End Caps: Shall be made of injection molded ABS Fire Retardant plastic.
9. Medical Gas Outlets: The outlet connection type shall be as called for on the signed approval documents.
10. Medical Gas Manifold: Medical gas distribution shall be supplied by pipe drops to the single point termination zone as indicated on the drawing. All Medical Gas Outlets and piping shall be brazed and tested in accordance with NFPA 99c. All Medical Gas piping shall be Type L copper pipe. Each outlet, piping and manifold shall pass a 24 hour standing pressure test.
11. Electrical Wiring:

    a. Wire for standard and critical branch power circuits shall be #10 or #12 (as specified) type THHN stranded copper wire, 600 volt, with heat resistant thermoplastic insulation for hot (black) and neutral (white). Grounds shall be #10 type R THHN stranded copper wire (green). All ground conductors shall be installed in conduit.

12. Electrical contractor shall insure compatibility of plug on accessory equipment to be used with these devices:

    a. Duplex Receptacles shall be NEMA style 5-15R or 5-20R, color Ivory for use on normal power circuits, and color Red for use on critical branch power circuits.
    b. Simplex Receptacles shall be NEMA style 5-15R or 5-20R, color Ivory for use on normal power circuits, and color Red for use on critical branch power circuits.
    c. Safety Receptacles (if required) shall be duplex type, be NEMA style 5-15R or 5-20R, color Ivory for use on normal power circuits, and color Red for use on critical branch power circuits. Receptacles shall limit proper access to energized contracts and shall accept both 2 wire and 3 wire plugs.
    d. Locking Receptacles (if required) shall be simplex type, 20 amp, 120 or 277 volt, color black, and be HUBBELL lock 23000 HG style, or equivalent.

13. Grounding and Bonding:

    a. All ground conductors shall be installed in conduit. Each power receptacle shall have a ground conductor connected to a grounding screw. A grounding bus will be installed in each device barrier box at rough in locations, and shall be installed as to insure grounding for the complete power system.
    b. Electrical Receptacles: Shall be Hospital Grade 15 or 20 amp, 120 or 277 volt, UL listed and marked Hospital Grade.

14. Low Voltage Data Provisions:

    a. Shall be connected to device junction box via conduit or raceway. Include pull cord extending from junction box to service provision. Telephone jack, blank faceplates, Data port or other Low Voltage device shall be furnished, installed and wired.

15. Switching:

    a. Shall be Industrial Grade 120 or 277 volt, 15 or 20 amps. Switch type options include SPST, 3-Way or Momentary, as shown on submittal shop drawings. Low Voltage Switching will be 0-12 volts, 15 amps unless otherwise noted. Provide, pre-install and wire all switches.

16. Lighting:

a. Provide overbed lighting system. Two fluorescent fixtures and ballasts shall be located in the overbed light enclosure. These fixtures provide lighting on and above the patient bed. Each fixture shall accommodate four (4) fluorescent bulbs.

17. All med gas piping shall be hard-piped and brazed to a single point of connection.

C. Medical Gas Outlets:

1. Basis of Design Manufacturer: Amico; Alert-1 series, DISS type or Architect approved equal.
2. Materials:

a. Outlets shall be manufactured with a 197 mm length type “K” 12.7 mm outside diameter 9.5 mm nominal size copper inlet pipe stub which is silver brazed to the outlet body.
b. The body shall be of 33 mm diameter, one piece brass construction.
c. For positive pressure gas services, the outlet shall be equipped with a primary and secondary check valve and the secondary check valve shall be rated at a maximum of 1,379 kPa in the event the primary check valve is removed for maintenance.
d. Outlet bodies shall be gas specific by indexing each gas service to a gas specific pin indexing arrangement on the respective identification module.
e. Mounting Hardware: Manufacturer's standard concealed type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for service connections, installation tolerances, and other conditions affecting performance of work.

B. Examine roughing-in for piping, electrical, and communications systems to verify actual locations of piping connections before headwall installation.

3.2 INSTALLATION

A. General: Install patient bed service wall systems according to Shop Drawings and manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building. Securely attach access panels, but provide for easy removal and secure reattachment.

B. Field-attached to the horizontal tiers and vertical frame sections.

C. Conceal channel fasteners behind snap-in vinyl trim.

D. Comply with requirements in Divisions 22, 26, and 27 Sections for installing medical gas service fittings and electrical devices.

E. Install fittings according to Shop Drawings and manufacturer's written instructions. Securely anchor fittings to patient bed service walls unless otherwise indicated.

3.3 PIPING INSTALLATION.

A. Clean, rinse, and dry tubing and fittings prior to manifolding in accordance with NFPA 99.

B. Securely cap and properly identify tubing ends.

C. Protect copper tubing from galvanic corrosion caused by contact between dissimilar metals.

D. Requirements for making final connections between patient bed service walls medical gas outlets and medical gas supply lines are specified in Division 22 Sections.

3.4 ELECTRICAL CONNECTION INSTALLATION

A. Requirements for making final connections between patient bed service walls lighting, electrical, and communications fixtures to service rough-ins are specified in Division 26 and 27 Sections.

B. Requirements for lamping patient bed service walls are specified in Division 26 Sections.

3.5 COMMUNICATIONS INSTALLATION

A. Requirements for making final connections between patient bed service walls communication devices to service rough-ins are specified in Division 27 Sections.

3.6 FIELD QUALITY CONTROL

A. Field pressure test installed gas lines according to requirements specified in Division 22 Sections.

B. Field test installed electrical connections according to requirements specified in Division 26 Sections.

C. Field test installed communication connections according to requirements specified in Division 27 Sections.

D. Adjust patient bed service walls, until tested patient bed service walls perform as specified.

E. After making corrections, retest patient bed service walls that failed to perform as specified.

3.7 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand.

B. Clean finished surfaces; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain headwall units. Refer to Division 01 Section "Closeout Procedures."

END OF SECTION 102513

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall Guards.
2. Corner guards.
3. End Guards.
4. Impact-resistant wall coverings.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, fire test response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Wall and Corner Guards: 300 mm long. Include examples of joinery, corners, end caps, top caps, and field splices.
2. Handrails: 300 mm long. Include examples of joinery, corners, and field splices.
3. Impact-Resistant Wall Covering: 150 mm by 150 mm square.

D. Qualification Data: For qualified Installer.

E. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 203 mm long units.
2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than 609 mm to 1219 mm long units.

B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 21 deg C during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 21 deg C.

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install impact resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 21 deg C for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform load of 0.73 kN/m applied in any direction.
2. Concentrated load of (0.89 kN) applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

B. Surface Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

C. Regulatory Requirements: Comply with International Building Code and Local Accessibility Standards and Guidelines.

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Construction Specialties, Inc.
2. InPro Corporation (IPC).
3. A. R. Nelson Co.
4. Architect approved equal.

2.2 MATERIALS

A. Source Limitations: Obtain impact resistant wall protection units from single source from single manufacturer.

B. PVC Plastic: ASTM D 1784, Class 1, textured, chemical-and-stain-resistant, high-impact-resistant PVC or acrylic modified vinyl plastic with integral color throughout, extruded and sheet material, thickness as indicated.

1. Impact Resistance: Minimum 25.4ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
2. Chemical and Stain Resistance: Tested according to ASTM D 543.
3. Self-extinguishing when tested according to ASTM D 635.
4. Flame-Spread Index: 25 or less.
5. Smoke-Developed Index: 450 or less.

C. Aluminum Extrusion: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 for Alloy 6063-T5.

D. Stainless-Steel Sheet: ASTM A 240/A 240M.

E. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fastners where exposed to view.

2.3 WALL GUARDS

A. Crash Rails: Stainless Steel Wall Guard with tubular mounting bracket and neoprene gasket. Wall guard shall have exposed mounting fasteners.

1. Material: Type 304 stainless steel with a #4 satin finish.
2. Minimum Size: 102 mm height by 84mm deep.
3. Mounting: Surface mounted directly to wall. Wall guard mounting bracket shall be extruded from 6063-T5 aluminum with a clear anodized finish.
4. Neoprene Gasket shall be fabricated from 70A durometer neoprene.

B. Handrails: Continuous aluminum rail system capable of supporting weights up to 453 kg made of 2 mm thickness shall be fabricated from 6063-T5 aluminum with stainless steel brackets that shall be made of type 201SS with type 304 stainless steel flange cover. Color of stainless steel shall be #4 satin finish stainless.

1. Handrail returns, outside corners and inside corners shall be stainless steel and a finish/color to match handrails.
2. Stainless steel brackets shall be fabricated from cast stainless steel with a brushed finish or a powder coat finish as selected by Architect.
3. Bracket Gasket: Gasket shall be .79mm, 70 durometer Neoprene. Color shall be black.
4. Fasteners: Provide all mounting systems accessories appropriate for substrates indicated.

2.4 CORNER GUARDS

A. Surface-Mounted, Stainless Steel Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.5 END GUARDS

A. Surface-Mounted, Stainless Steel End Guards: Fabricated as one piece from formed or extruded metal with formed edges; to match wall condition.

1. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.6 IMPACT-RESISTANT WALL COVERINGS

A. Impact-Resistant Sheet Wall Covering: Fabricated from plastic sheet wall-covering material.

1. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
2. Mounting: Adhesive.

2.7 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to product flush, smooth, and rigid hairline joints.

2.8 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Remove tool and die marks and stretch lines, or blend into finish.
2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
3. Run grain of directional finishes with long dimension of each piece.
4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

    a. Provide anchoring devices to withstand imposed loads.
    b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
    c. Adjust end and top caps as required to ensure tight seams.

B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

C. Hygienic Wall Covering: Install in accordance with the current published manufacturers installation guide. All joints should be joined by approved methods as detailed in the installation guide.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 -TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Custodial accessories.
3. Pass-thru specimen cabinet.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Toilet Accessory Schedule on Drawings for basis of design manufacturer's, descriptions, model numbers, profiles and materials.

1. Comparable products by one of the following:

a. A & J Washroom Accessories, Inc.
b. American Specialties, Inc.
c. Bradley Corporation.
d. Architect approved equivalent.

2.2 GENERAL MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

C. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

D. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue Holder:

1. Description: Mounted Multi-Roll Toilet Tissue Dispenser.
2. Material and Finish: Stainless steel.
3. Mounting: Surface mounted.
4. Door: Front of door is drawn, one-piece, seamless construction. Secured to cabinet with two rivets. Equipped with a tumbler lock.

B. Paper Towel Dispenser:

1. Surface mounted, designed for nominal 100 mm depth.
2. Minimum Capacity: 600 C-fold or 800 multifold towels.
3. Lockset: Tumbler type, sample to be approved.
4. Refill Indicators: Pierced slots at sides or front. Samples to be approved.
5. Material and Finish: Stainless steel.

C. Soap Dispensers:

1. Description: Surface-mounted stainless steel soap dispenser with corrosion-resistant valve that dispense hand soaps.
2. Valve shall be operable with one hand and with less than 5 pounds of force (22.2 N).
3. Container shall be equipped with a clear acrylic refill-indicator window; a locked, hinged stainless steel lid for top filling and shall have a capacity of 40-fl oz (1.2-L). Unit shall have concealed, vandal-resistant mounting.

D. Grab Bars:

1. Tubing: Type-304, 18-gauge stainless steel tubing with satin-finish and slip-resistant texture in grip area. 1-1/2-inches (38 mm) outside diameter. Grab bar ends are heliarc welded to flanges. Clearance between the grab bar and wall 1-1/2-inches (38 mm).
2. Concealed Mounting Flanges: Type-304, 11-gauge thick, stainless steel plate; end flanges 2 inches (50 mm) by 3-1/8-inches (79 mm) with holes for attachment to wall. Intermediate flanges 2-5/8 inches 67 mm) by 3-1/8-inches (79 mm) wide by 3-1/8-inch (79 mm) diameter.
3. Snap Flange Covers: Type-304, 22-gauge drawn stainless steel with satin-finish. 3-1/4-inches (83 mm) diameter by 1/2-inch (13 mm) deep.
4. Bariatric Grab Bars: Where indicated, provide grab bars with load capacity of 1,000 lbs (454 kg) minimum stainless steel.
5. Configuration and Length: As indicated on Drawings.

E. Glass Mirrors:

1. Frame: 18-8, Type-430 stainless steel, 1/2-inch (13 mm) by 1/2-inch (13 mm) by 3/8-inch (10 mm) channel with 1/4- inch (6 mm) return at rear for snap locking design; 1/2-inch (13 mm) by 1/2-inch (13 mm) by 1/2-inch (13 mm) channel for lock tab design, with bright polished finish. One-piece frame with 90 degree mitered corners. Galvanized steel back with integral horizontal hanging brackets at the top and near the bottom.
2. Mirror: No. 1 quality, 1/4-inch (6 mm) select float glass selected for silvering, electrolytically copper-plated by the galvanic process, Mirror back shock-absorbing, water-resistant, nonabrasive, polyethylene padding.
3. Concealed Wall Hanger: Galvanized steel construction.

A. Robe Hooks:

1. Surface-mounted double robe hook shall be type-304 stainless steel with satin finish.
2. Flange and support arm shall be 22 gauge and equipped with a concealed, 18-gauge mounting bracket that is secured to a concealed, 19-gauge wall plate with a stainless steel setscrew. Cap shall be 14 gauge, welded to the support arm.

B. Shower Rods:

1. Curtain Rod: 18-8, type-304, 20-gauge stainless steel tubing with satin finish. 25 mm outside diameter by 1.2 mm wall thickness.
2. Flanges: 18-8, type-304, 20-gauge stainless steel with satin finish. Drawn, one-piece, seamless construction.

C. Towel Holders:

1. Wall-mounted towel rod, stainless steel tube, towel rack, 60 cm long, load max up to 11 5 kg.

D. Underlavatory Guards:

1. Basis of Design Product: Truebro, Inc.; Lav Guard2 or Architect approved equal.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.
4. Location: All sinks.

2.4 CUSTODIAL ACCESSORIES

A. Mop and Broom Holders:

1. Utility shelf with mop/broom holders and rag hooks shall be 18-8, type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Each hook attached to mounting strip with two rivets.

    a. 4-hooks
    b. 3-mop holders

2. Shelf shall be 18 gauge, 8-inches (203 mm) deep with 3/4-inch (19 mm) return edges, and shall have front edge hemmed for safety.

2.5 SPECIMEN PASS-THRU CABINETS

A. Basis of Design manufacturer: Bobrick model #B-505 or Architect approved equal.

B. Specimen Pass-Thru Cabinets:

1. Specimen pass-thru cabinet shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish.
2. Flanges shall be drawn and beveled, one-piece, seamless construction. Spring-loaded doors shall be self-closing and secured to cabinet with a full-length stainless steel piano-hinge.

3. Doors shall be equipped with interlocking mechanism to prevent the door from opening when the other door is open, providing sight-barrier for complete privacy. International graphic symbol on doors shall identify specimen cabinet. Unit shall be furnished with a removable stainless steel spillage tray.
4. Tray: 18 gauge, Type 304 removable stainless steel tray.
5. Compliance: International Building Code Accessibility Standards for operation with one hand with less than 5 pounds of force.

2.6 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for fire extinguishers and hose reels.
2. Fire-protection cabinets for fire blankets.

1.3 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples 152 mm by 152 mm square.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304.

1. Finish: No. 4 directional satin finish.

B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FIRE PROTECTION CABINETS FOR FIRE EXTINGUISHERS

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cosmopolitan manufactured by J.L. Industries or comparable product by one of the following:

a. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
b. Larsen's Manufacturing Company.
c. Architect approved equal.

B. Cabinet Construction: Non fire-rated and fire-rated types.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls lined with minimum 5/8-inch-thick fire-barrier material.

C. Cabinet Material: Stainless steel sheet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

E. Door Material: Stainless steel sheet.

F. Door Style: Fully glazed panel with frame.

G. Door Glazing: Tempered float glass (clear).

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim permitting door to open 180 degrees.

I. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Application Process: Decals.
2) Lettering Color: Red.
3) Orientation: As indicated on Drawings.
4) Orientation: Vertical.

2.4 FIRE PROTECTION CABINETS FOR FIRE BLANKETS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Cosmopolitan manufactured by J.L. Industries or comparable product by one of the following:

1. Larsen's Manufacturing Company.
2. Architect approved equal.

B. Cabinet: Model No. 9613S21 The Royal.

1. Surface-mounted tub and solid metal door. The Royal series is available in red epoxy-painted CRS only. Door hardware includes zinc-plated pull handles and roller catches.

C. Blanket: Nominal 62" x 84", 3 1/2 pound, processed wool fire blanket, which meets the Flammable Fabrics Act: Flammability of Clothing Textiles, Title 16, CFR1610 .

2.5 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Identification: Apply lettering either at the factory or just prior to Substantial Completion.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Coordination:

1. Whether shown or not, provide not less than one fire extinguisher to be installed in cabinets for each not to exceed 23 meters of travel distance.
2. Provide one wall hung fire extinguisher with bracket and install in each mechanical, electrical, elevator machine and storage rooms.

1.3 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.4 SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers" or per regulations of local authorities having jurisdiction.

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 FIRE EXTINGUISHERS

A. Cabinet Type: Suitable for fire extinguisher.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cosmopolitan manufactured by J.L. Industries or comparable product by one of the following:

a. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
b. Larsen's Manufacturing Company.
c. Architect approved equal.

2.3 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Valves: Manufacturer's standard.
2. Handles and Levers: Manufacturer's standard.
3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:80-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container with chrome plated brass valve.

2.4 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.3 FIELD QUALITY CONTROL

A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag or per regulations of local authorities having jurisdiction just prior to turnover to Owner.

END OF SECTION 104416

SECTION 105116 - WOOD LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid wood lockers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of wood locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wood locker.

B. Shop Drawings: For wood lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show details full size.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in wood lockers.
5. Show wood locker fillers, trim, base, sloping tops, and accessories.
6. Show wood locker numbering sequence.

C. Samples for Verification: For the following products:

1. Solid wood panels with transparent finish, not less than 8 by 10 inches (203 by 254 mm) for each species and cut. Include at least one face-veneer seam and finish as specified.
2. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing wood locker doors and latching mechanisms to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Full-size wood locker doors, complete with specified door hardware. Furnish no fewer than five doors of each type and color installed.
2. Full-size units of the following wood locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

a. Hinges.
b. Pulls.
c. Shelf rests.
d. Cylinder and drawer locks.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wood locker on each side of corner and corner filler, including door panel with specified door hardware as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver wood lockers until painting and similar operations that could damage wood lockers have been completed in installation areas. If wood lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood lockers until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 16 and 32 deg C and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. Field Measurements: Where wood lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support wood lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where wood lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site,

and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.10 COORDINATION

A. Coordinate sizes and locations of concealed wood support bases.

1. Requirements are specified in Division 06 "Miscellaneous Rough Carpentry."

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that wood lockers can be supported and installed as indicated.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wood lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of locks or hardware.
c. Deterioration of wood, wood finishes, and other materials beyond normal use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOLID WOOD LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by Firestone Natural Rubber Company.

B. Construction Style: Flush overlay.

C. Materials: Fabricated from Hevea wood (“Rubberwood”) panels clear hardwood lumber, selected for compatible grain and color.

2.2 WOOD LOCKER COMPONENTS

A. Locker Body:

1. Side Panels: 19 mm thick.
2. Back Panel: 13 mm thick.
3. Top Panel: 19 mm thick.
4. Bottom Panel: 19 mm thick.
5. Exposed Panel Edges: Solid wood to match doors.

B. Flush, Solid-Wood Doors: 19-mm thick solid wood, end and edge glued.

C. End Panels: Match style, material, construction, and finish of wood doors.

D. Shelves:

1. Thickness: 19 mm.
2. Exposed Edges: Solid wood to match doors.

E. Drawer Faces: Match style, material, construction, and finish of wood doors. Attach drawer faces to subfronts with mounting screws from drawer interior.

F. Drawer Subfronts, Sides, and Backs:

1. Thickness: 13 mm.
2. Exposed Edges: Solid wood to match doors.

G. Drawer Bottoms: 6-mm thick.

H. Corners and Filler Panels: 19-mm thick panel. Match style, material, construction, and finish of wood doors.

I. Continuous Finish Base: Wood-faced, 19-mm thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of wood lockers.

J. Continuously Sloping Tops: Wood-faced, 19-mm thick panel that matches door faces for installation over wood lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures.

1. Sloping-top corner fillers, mitered.

K. Grain Matching: Run and match grain vertically for doors and fixed panels.

L. Transparent Finish: Manufacturer's standard two-coat, clear, catalyzed lacquer finish with sanding between coats. Seal with moisture-resistant topcoat.

1. Stain: Match Architect's sample.

M. Painted Finish:

1. Color: Match Architect's samples.

N. Factory finish wood lockers as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

1. Preparations for Finishing: Sand, fill countersunk fasteners, seal concealed surfaces, and perform similar preparations for finishing wood lockers, as applicable to each unit of the Work.
2. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood lockers. Apply two coats to back and end of paneling.

2.3 MISCELLANOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors.

Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Wood Support Base: 51-by-102-mm, actual-size lumber treated with manufacturer's standard preservative-treatment, pressure process.

2.4 HARDWARE

A. Cam Padlock Hasp: Surface mounted, steel; finished to match other wood locker hardware.

B. Semiconcealed Hinges: Single-pivot, spring-loaded steel hinges; back mounted.

1. Provide two hinges for doors 1067 mm high and less.
2. Provide three hinges for doors more than 1067 mm high.

C. Wire Pulls: Back mounted; 1020 mm long, 8 mm in diameter, 62 mm deep.

D. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.

E. Shelf Rests: BHMA A156.9, B04013.

F. Hooks: Manufacturer's standard, ball-pointed aluminum or steel. Attach hooks with at least two fasteners.

1. Provide one double-prong ceiling hook and two single-prong wall hooks for each compartment of wood lockers.

G. Exposed Hardware Finishes: Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

2.5 ACCESSORIES

A. Number Plates: 38 mm diameter, etched, embossed, or stamped, aluminum plates with black numbers and letters at least 13 mm high. Identify wood lockers in sequence indicated on Drawings.

2.6 FABRICATION

A. Fabricate each wood locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate wood lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-wood members to 1.5 mm radius.

B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate wood lockers with joints that are dadoed or rabbeted, glued full length, and stapled. Dado side panels to receive shelving except where indicated to be adjustable.
2. Join drawer subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 381 mm above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 1219 mm above the floor.

D. Venting: Fabricate wood lockers with space between doors and locker assembly of not less than 6 mm with painted metal security screen attached to each shelf between doors.

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive wood lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition wood lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing wood lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install wood support base with 13-mm thick plywood top.

B. Install wood lockers level, plumb, and true; use concealed shims.

C. Connect groups of wood lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit wood lockers accurately together to form flush, tight, hairline joints.

D. Install wood lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 3 mm in 2400-mm sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Locker Anchorage: Fasten wood lockers through back, near top and bottom, at ends with No. 8 flush-head wood screws sized for 25-mm penetration into wood framing, blocking, or furring and spaced not more than 400 mm o.c.

F. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

G. Attach sloping-top units to wood lockers, with end panels covering exposed ends.

H. Install number plates after wood lockers are in place.

1. Attach number plate on each wood locker door, near top, centered, with at least two screws with finish matching number plate.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Protect wood lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace wood lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by wood locker manufacturer.

END OF SECTION 105116

SECTION 111200 - PARKING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual barrier gates.

B. Coordination: Concrete specified in Section 033000 "Cast-In-Place Concrete; minimum 2,500 psi strength at 28 days. Coordinate final design with Engineer.

1.3 ACTION SUBMITTALS

A. Product data.

B. Shop Drawings: For parking control equipment.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For parking control equipment to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 MANUAL BARRIER GATES

A. Basis of Design Manufacturer: Subject to compliance with requirements, provide products by Bollard Street; Heavy Duty Barrier or Architect approved equal.

B. Components, Includes but not limited to:

1. Counter balanced manual raise arm barrier. The barrier must be locked at all times when in the upright position to secure it in place.
2. Heavy duty raise arm barrier span up to 9.0 meters. Pivot assembly made of steel box section, pivots on two heavy duty stainless steel bearing blocks.
3. Aluminum Arm: locking mechanism allows the barrier in the raised and lowered position prior to applying the padlock.
4. A counter balanced fish tail weight, lockable end rest, padlock and keys. 40 mm.
5. Anchor bolts and Base plates.
6. Boom diameter: 101 mm oval section pole.
7. Finish: Polyester powder coated.
8. Colors: As selected by Architect.
9. Dimensions: 120 mm square.
10. Lockable end post.
11. Padlock.
12. Anchor shield bolts.
13. Lifting handle.
14. Stop/No Exit, Caution signs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Barrier Gates:

1. Install per manufacturer’s written instructions and recommendations.
2. Anchor to concrete bases/footings with anchor bolts or expansion anchors, and mount barrier gate arms.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Parking control equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain parking control equipment.

END OF SECTION 111200

SECTION 123551 - LABORATORY CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This section is only a portion of the Contract Documents. All of the Contract Documents, including Conditions of the Contract and Division 01 General Requirements, apply to this section.

1.2 SUMMARY

A. Section Includes:

1. Wood Lab Casework.
2. Shelving.
3. Laboratory accessories.

1.3 SUBMITTALS

A. Shop Drawings: Provide large scale plans and elevations of casework, cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to windows, doors, surrounding walls and other building components.

B. Product Data: Submit manufacturer's catalog for reference. Include cabinet dimensions, configurations, construction details, joint details, attachment details, and rough-in details as required.

1.4 QUALITY ASSURANCE

A. Single source: Casework and fume hoods to be manufactured and furnished by a single laboratory furniture company.

B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:

1. Minimum of ten (10) years experience in manufacture of wood laboratory casework and fume hoods.
2. Ten (10) installations of equal or larger size.

C. Installer qualifications: Certified by the manufacturer.

D. SEFA 8: Laboratory Furniture Recommended Practices.

E. SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment.

F. SEFA 3 – Work Surfaces

G. SEFA 7 – Laboratory and Hospital Fixtures

H. Manufacturer to provide load test results certified by an independent testing laboratory for drawers, doors, suspension slides and unit shelving.

I. Finish for Wood Laboratory Products

1. All Wood Laboratory Products shall utilize an environmentally friendly, laboratory grade, water-borne finish. Any solvent applied coatings shall not be acceptable and will not be considered.
2. Chemically Resistance Finish: Only highly chemically resistant water-borne finish that passes the casework specifications listed for chemical and durability resistance will be acceptable. A letter from a third-party testing agency, verifying independent test results, shall be submitted to the Owner Representative/Architect for approval - prior to award of contract.
3. Off gasing: After all wood products have cooled from the curing ovens, the coating shall be firm and stable. No further emissions or “Off gasing/Decomposition” vapors shall occur at room temperature.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver laboratory casework and work surfaces to job site only after wet operations in construction site are completed and proper facilities are available for handling, storage and protection. Use blanket wrap reusable packing for delivery.

B. Proper precautions must be taken to minimize temperature, moisture, and impact issues during shipment to site.

C. Store laboratory casework in a ventilated area, protected from the weather, with relative humidity of 50% or less, at 22 degrees C.

D. Replacements: In the event of damage immediately replace.

E. Casework: Protect finished surfaces from soiling or damage during handling and installation.

F. Work surfaces: Protect throughout the construction period.

1.6 PROJECT CONDITIONS

1. The casework supplier is responsible for details and dimensions not controlled sections of the specifications. The laboratory casework installer shall coordinate work of this section with all other affected trades in advance of installation. Shop drawings shall show field dimensions and conditions as required for the subsequent installation of other work into the casework.
2. The Contractor, Casework Manufacturer and Installer shall establish and maintain these field dimensions and conditions through completion.

1.7 WARRANTY

A. Furnish a written warranty covering the work of this section for a period of two (2) years from the date of substantial completion against defects or non-conforming materials and/or workmanship. Defects include, but are not limited to:

1. Ruptured, cracked, or stained coating.
2. Weld or structural failure.
3. Slippage, shifts, or failures of connected components, including attachments to wall, floor, ceiling, or building structure.
4. Warping or unloaded deflection of components.
5. Discoloration or lack of finish integrity.
6. Cracking or peeling of finish.
7. De-lamination of plastic laminate or edge banding.
8. Visible weld marks.
9. Sealant deterioration, shrinkage, or failure.

1.8 COORDINATION

A. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

1.9 EXTRA MATERIALS

A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

C. Maintenance Manuals:

1. Submit for Owner's review and use, three complete operations and maintenance manuals that describe proper maintenance and replacement schedules, components and parts list. Provide point of contact for factory representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Lab Casework Manufactures:

1. Mott-ALC.
2. CIF Solutions.
3. CampbellRhea.
4. Architect approved equal.

B. Acceptable Laminate Shelving Manufactures:

1. Trespa North America.
2. Inter Dyne Systems.
3. CampbellRhea.
4. Architect approved equal.

C. Acceptable Metal Shelving /Accessories Manufactures:

1. Inter Dyne Systems.

2. CIF Solutions.
3. CampbellRhea.
4. Architect approved equal.

2.2 WOOD CASEWORK DESIGN

A. Door and Drawer Design:

1. FLUSH OVERLAY: Square edged flush overlay design with 3 mm reveals between door or drawer and frame, door to door, door to drawer, drawer to drawer; 1.58 mm vertical reveal between doors/drawers and cabinet ends.

B. Standard grain pattern on end panels is vertical.

C. Grain pattern on cabinet fronts:

1. VERTICAL MATCHED GRAIN: Continuous vertical grain match on door and drawer fronts of individual cabinets.

D. Cabinet end panels exposed to view after installation must be specified as a "finished end" panel. All end panels not exposed to view after installation will be as listed under "unexposed" plywood.

E. Cabinets to be rigid, self-supporting design for use in assembly or as single, interchangeable stand-alone units. Suspended units are without sub-base.

F. Flush Interiors: Surface mounted bottoms and offsets caused by front face frames, which interfere with ease of cleaning, are not acceptable.

G. Joinery: 32 mm doweled joinery system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8 mm.

2.3 CASEWORK MATERIALS

A. Definition of cabinet components by surface visibility: Reference to the surfaces below will be made in later paragraphs when describing surface materials and finishes.

1. Exposed Surfaces

a. Surfaces visible when drawers and solid doors are closed.
b. Surfaces visible behind clear glass doors.
c. Interior surfaces of open units.
d. Bottoms of cabinets 1066 mm or more above finished floor.
e. Tops of cabinets less than 1828 mm above finished floor.

2. Semi-Exposed Surfaces

a. Surfaces visible when solid doors are open.
b. Bottoms of cabinets 762 mm but less than 1066 mm above finish floor.
c. All front edges of shelving behind doors.

3. Concealed Surfaces

a. Surfaces not normally visible after installation.
b. Bottoms of cabinets less than 762 mm above finished floor.

c. Stretchers, blocking, components concealed by drawers.

B. Hardwood:

1. Hardwood lumber, clean and free of defects. All lumber kiln-dried to uniform moisture content of six percent.

a. Exposed material:
b. Hard Maple, Grade 1 Minimum or local equivalent.
c. Semi-exposed material - Select hardwood
d. Unexposed material - Sound hardwood of species suitable for the intended purpose.

C. Plywood:

1. Core: 7-ply and 9-ply veneer core plywood with cross and face plies bonded with Type II water-resistant glue; drawers are nine-ply, 38 mm thick.
2. Face veneer:

a. Exposed surfaces:

1) Rotary-cut select sap hard maple veneer, (no heartwood), grade A or local equivalent. Book matched, running matched only.

a) Semi-exposed: Same species as specified for exposed face veneer, grade 1 for maple. Birch, poplar or other hardwoods or softwoods are not acceptable.
b) Unexposed: Same species as specified for exposed and semi-exposed veneer, grade at option of manufacturer. Birch, poplar or other hardwoods or softwoods are not acceptable.

D. Welded fiberboard: Wood fibers and resin binders formed under heat and pressure.

E. Glass - Where occur, provide minimum 6mm tempered safety glazing without imperfections or marred surfaces.

F. Glue: Laminating - Type II water-resistant; assembly - Type III water-resistant.

G. Edgebanding: 3 mm hardwood on all edges of doors and drawers; fronts of shelves, base, wall, upper and tall cases. Bottoms and tops of wall, upper and tall case end panels to be 5 mm.

H. Finish: Exposed and semi-exposed surfaces to have a highly chemical resistant, HAP's (Hazardous Air Pollutants) free water based finish with built in U.V. blocker and stain. A minimum of 10 stain color choices shall be available. Finish must have less than 0.907 kg per gallon of VOC's per EPA Method 24. Products with Aziridin and Iso-cyanate will not be allowed.

I. Auxiliary cabinet materials: Acid Storage-Cabinet Lining: 6 mm-thick, polyethylene or polypropylene.

2.4 CASEWORK FABRICATION

A. Base Units:

1. Cabinet ends: 19 mm thick plywood (for both exposed and unexposed ends) with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes:

    a. Provide four metal corner gusset levelers with threaded adjustment screws and floor pad on all base cabinets.

2. Top rails: Full Top Frame

    1) Horizontal front top rail: 25 mm x 76 mm solid hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
    2) Vertical back top rail: 19 mm x 95 mm hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
    3) Top side rails: 19 mm x 38 mm hardwood between front horizontal and back vertical rails, glued and screwed in place.

3. Intermediate rails:

    a. Front horizontal intermediate rail: 19 mm x 38 mm exposed hardwood rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8 mm dowel joinery. (Front intermediate rails will always be furnished on Lipped Overlay cabinets and on locked and keyed differently cabinets.)
    b. Intermediate Rear Rail: 19 mm x 38 mm hardwood rail, secured to cabinet end panels with glued 8mm dowel joinery. (Front and rear intermediate rails will always be furnished if security panels are included on locked and keyed differently cabinets.)

4. Toe space rail: 95 mm x 19 mm hardwood or 7-ply veneer core plywood, mounted between end panels with glued 8 mm dowel joinery and metal fasteners, forming a 101 mm high x 63 mm deep toe space, closed to cupboard bottom.

5. Bottoms: 19 mm thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels on 96 mm spacing and metal fasteners. Front edge to be banded with 3 mm hardwood banding. Suspended units to be 25 mm thick. Removable bottoms are not acceptable.

6. Backs:

    a. Cupboard units - one-piece 4.7 mm thick hardboard, rabbetted into rear top rail for easy removal from inside of cabinet.
    b. Drawer units: Removable 4.7 mm hardboard split back panels, rabbetted into top rail.
    c. Sink units - half-height, one piece 4.7 mm thick hardboard, rabbetted into rear rail for easy removal from inside of cabinet.

7. Vertical dividers in combination cabinets: 38 mm thick plywood panel (frames not permitted) glued and screwed in place, top and bottom, with 3 mm hardwood banding on front edge.
8. Shelves (base units);

    a. Veneer core plywood, 3 mm hardwood banded on front edge, adjustable on 32 mm centers:

        1) Depth: Split-depth, two shelves, each 228 mm deep
        2) Thickness: 25 mm thick for all shelves.

9. Drawer construction:

    a. Box: Four-sided drawer box with back, front and sides of 12 mm 9-ply Birch plywood or local equivalent with chemical-resistant finish and finished top edges. (Three-sided drawer box attached to outer drawer front is not acceptable.) Sides shall be joined by Multiple dovetail all four corners.
    b. Bottom: Nominal 6 mm, inset into all four sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Material to be: White PVC clad MDF board (dovetail only).

10. Door and removable drawer front construction:

    a. 3 ply 19 mm thick particleboard core plywood with 3 mm hardwood banding on all four edges.

11. Fillers, knee space panels, scribes, etc.: Shall be of same species and grade as adjacent exposed surfaces, either 19 mm thick veneer core plywood or lumber as required, with same stain and finish.
12. Pull boards: 25 mm thick plywood with balanced laminated faces. Front to be hardwood of same species and same reveals specified for cabinet exterior. Suspension to be 3/4 extension, open roller, 34 kg dynamic load, self-closing, with hold-open feature and epoxy-coated.

B. Wall and Tall cases:

1. Shall be manufactured with appropriate materials and joinery methods as specified for base units except as noted below.
2. Tops: 25 mm thick, 9-ply veneer core plywood with 3 mm hardwood banding on front edge.
3. Bottoms:

    a. 19 mm thick, 7-ply veneer core plywood with 3 mm hardwood banding on front edge. Bottom plywood kick rail 95 mm high joined to cabinet sides.

4. Backs: 6 mm thick veneered plywood with backs recessed 22 mm and set into top, bottom and ends, sealed with hot melt glue process around entire perimeter.
5. Shelves: veneer core plywood, 3mm hardwood banded on front edge, adjustable on 32 mm centers.

    a. Solid door cabinets: 25 mm thick, 9-ply, for all shelves.
    b. Open and glass door cabinets: 25 mm, 9-ply, for all shelves.

6. Door construction:

    a. (Flush overlay only). 19 mm 3 ply thick particleboard core plywood with 3 mm hardwood banding on all four edges.

7. Framed glass doors: Solid hardwood, 19 mm x 69 mm frame stock machined to accept glass, mitered joints, extruded vinyl retaining molding to allow glass to be replaced without tools. With lipped overlay, meeting edges of pairs of doors to include overlapping astragals: right over left.

C. Hardware:

1. Standard drawer suspension:

a. Full extension with over travel, ball-bearing roller, 68 kg. dynamic load, zinc-plated Accuride 4034 series or Architect approved equal. Drawer bodies less than 101 mm to be furnished with full extension, 45 kg dynamic load, zinc-plated Accuride 3832 series slides or Architect approved equal.

2. File drawer suspension: Full extension with over travel, ball-bearing roller, 68 kg dynamic load, zinc-plated Accuride 4034 series or equal. File drawers shall have built-in hanging system.

3. Drawer and hinged door pulls: Stainless steel wire pulls, 101 mm.

   a. All pulls are mounted horizontally on drawers and vertically on doors.

4. Hinges: Provide two hinges for doors up to 1.21 m high; three hinges for doors over 1219 mm high. Notch for proper fit.

   a. 5-knuckle, institutional style, hospital tipped, stainless steel.

5. Unit shelf supports: Metal pin and socket.
6. Elbow catches: Spring type with strike.
7. Locks, where indicated on drawings: 5-pin tumbler for MASTER key system per Owner requirements.

2.5 WOOD FINISH – to be environmentally friendly, water based.

A. Chemical Resistance Test Procedure: Finished panels shall be oriented horizontally and vertically during exposure to the test chemicals. Chemical concentrations shall be adjusted by the volume method. Ambient temperature and chemical temperature shall be 20-22 C. At the end of the test period, the surface shall be washed with detergent and warm water. Areas exposed to solvents shall be cleaned with a cloth dampened with the respective solvent. Prior to evaluation, 16-24 hours after the chemicals have been removed; the test surface shall be scrubbed with a damp paper towel and dried with paper towels.

2.6 WORK SURFACES

A. Countertops, General: Refer to Division 12 for countertop work.

2.7 SHELVING

A. Stainless-Steel Shelving: Made from 18 gauge, Type 304 stainless steel #4 finish, 101 mm high stainless steel wrap around.

B. Brackets and Standards: Wall mount standards manufactured with 14 gauge material, all brackets from 16 gauge.

2.8 LABORATORY ACCESSORY

A. Pegboards

1. Pegboards shall be of size noted, or if not noted shall be at least 609 mm by 609 mm
2. Board shall be of stainless steel coated with chemical resistant finish, on all faces and edges. Pegs shall be of coated stainless steel or polypropylene, protruding 152 mm at

45o angle. Base of peg shall be inserted into pegboard. Pegs shall not be bonded into the board but shall be held in by mechanical design with easy removal and replacement by hand. Pegs shall be in pattern as accepted in mock-up and/or submittal, but no less than six pegs per square foot.

3. 50 mm Drip Trough shall be fastened to pegboard with stainless steel fasteners and be 20-gauge type 304 stainless steel. The design shall provide for pitch to the front to assure full drainage. A 9 mm stainless steel tube outlet and flexible drain tube extending to the sink shall be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Casework installation:

1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1.58 mm tolerance.
3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by misc.rough carpentry, Division 06.
4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 3 mm between top units.

B. Work surface installation per Division 12 Countertop work.

C. Sink installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations.

D. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations.

3.2 ADJUSTING

A. Repair or remove and replace defective work, as directed by (Architect/Owner) upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.3 CLEANING

A. Broom clean finished casework, touch up as required.

B. Clean materials as recommended by manufacturer.

3.4 PROTECTION OF FINISHED WORK

A. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION 123551

SECTION 123600 - COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Terrazzo countertops and backsplashes.

a. Location: Typical countertops.

2. Epoxy resin-material countertops, backsplashes.

a. Location: General Lab.

3. Stainless steel countertops and backsplash.

a. Location: Blood handling-type rooms, Bio-hazard, TB Lab and Sterilization Rooms.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For countertop materials.
2. Adhesives and sealants.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, field joints, and cutouts for plumbing fixtures.

C. Samples for Verification: For the following products:

1. One full-size with front edge and backsplash, 203 mm by 254 mm, of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of product.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 16 and 32 deg C and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete. Indicate measurements on Shop Drawings.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include in maintenance manuals. Include product data for care of products used or recommended by Installer, and names, addresses, and telephone numbers of local sources for products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and handle countertops and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Store on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Refer to Finish Schedule on Drawings for Manufacturer's materials, colors and patterns not indicated.

2.2 TERRAZZO COUNTERTOPS

A. Manufactured Precast Cement Terrazzo Slab Units. Basis of Design: Wausau Tile or Architect approved equivalent.

1. Mold-to-size countertops and custom sized slabs as indicated on Drawings.
2. Top slab surface finished only.
3. Finished surface to be ground & polished, free of holes or rough areas. Finished surfaces to be uniform in appearance.
4. Materials:

a. 30 mm white terrazzo.
b. 100 percent white cement base (50 percent white cement 42.5 resistance, 50% white sand 0.25 or finer).
c. Grinding: Use gradually smaller grit diamond disc.
d. Dividers: White. Spacing shall not exceed 2000 mm.
e. Supports: Minimum 25 mm steel angle frame.

B. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

C. Material Test Results:

1. Compression - ASTM C 140 (8,560 psi or higher)
2. Absorption - ASTM C 140 (Results between 3.2 –5.3)
3. Flexural - ASTM C 293 (760 psi or higher)
4. Scratch Resistance / Mohr'sHardness: 6-8 Glass Aggregates, 5-8 Rock Aggregates, 4-6 Matrix.

2.3 EPOXY RESIN-MATERIAL COUNTERTOPS

A. Basis of Design Manufacturer: Subject to compliance with requirements, provide products as manufactured by Durcon Incorporated or Architect approved equal.

1. Location: Labs.

B. Fabricated from a molded modified epoxy resin that has been especially compounded and cured to provide optimum physical and chemical resistance.

1. Tops have a uniform mixture throughout, and do not depend on a surface coating that can be readily removed by chemical or physical abuse.
2. Surfaces: Flat worksurfaces.
3. Tops shall be 25.4 mm thick.
4. Color: Black.
5. Exposed edges: Chamfered back approximately 3 mm.
6. Backsplashes: Integrally molded 102 mm high with 15.87 mm coved juncture to top surface. Provide loose backsplashes where applicable.
7. Endsplash: Matching backsplash.
8. Penetrations: Location of cutouts and drillings: Plus or minus 3 mm. Sizes of cutout and drillings: Plus or minus 1.58 mm.
9. Sink Fabrication: Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line, bottom sloped to outlet drain. Provide manufacturer's adjustable support system.

a. Provide polypropylene strainers and tailpieces.

C. Laboratory Accessories

1. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop unless otherwise indicated.
2. Pegboards: Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

2.4 STAINLESS STEEL COUNTERTOPS

A. Constructed of 16-gauge type 304 stainless steel with #4 finish with stainless steel hat channels.

1. Mechanical hairline field joints when required. Field welding and polishing of field joints. Width: 762 mm front to back and include backsplash with 45 degree turn and z-clip.
2. Corners: Seamless sanitary cove or radius.
3. Front-Edge: Square.
4. Sink: Where occur fabricate integral with same material as countertop.

2.5 ACCSSORY MATERIALS

A. Provide adhesives as recommended by finish material manufacturer for each application.

B. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Division 07 "Joint Sealants" and will not stain the stone it is applied to.

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
2. Color: Clear unless otherwise indicated.

2.6 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 25.4 mm over base cabinets.

B. Complete fabrication, including assembly and finishing to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and back priming.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

D. Install countertops level to a tolerance of 3 mm in 2438 mm.

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and end splashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

G. Terrazzo countertops: For fabrication and installation please refer to the Marble Institute of America (MIA) Technical Module Residential Stone Countertop Installation Guidelines. Provide protectant per manufacturer's recommendations.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Terrazzo Countertops: Basis of Design cleaning product, Prosoco EnviroCLEAN 2010 All Surface Cleaner or Architect approved equivalent.

END OF SECTION 123600

SECTION 124816 - ENTRANCE FLOOR GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Recessed foot grilles.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide foot grilles capable of withstanding the following loads and stresses:

1. Wheel load of minimum 1000 lb. per rolling load capabilities

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for foot grilles and frames.

B. Maintenance Data: For foot grilles to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Accessibility Requirements: Provide installed foot grilles that comply with the International Building Code Accessibility Guidelines.

1.6 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product as manufactured by Construction Specialties, Inc.; PediTred G4, or Architect approved equivalent 19 mm deep recess grid with no frame.

2.2 MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15.

B. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer. Coat surface of frame in contact with cementitious materials with manufacturer's standard protective coating.

2.3 FOOT GRILLES

A. General: Provide manufacturer's standard foot-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.

B. Aluminum Foot Grilles: Provide manufacturer's standard foot grilles with extruded members, top-surfaced tread rails, and as follows:

1. Tread Rails: Extruded-aluminum tread rails with extruded-aluminum frame.
2. Tread Rail Spacing: 38 mm o.c. with 3- to 4.8-mm wide openings between treads.
3. Aluminum Finish: Anodized.

    a. Colors: As selected by Architect from manufacturer's full range.

4. HD MonoTuft Carpet: Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch and colorfast, solution-dyed nylon. Fiber and monofilament shall be fusion-bonded to a rifid two-ply backing. Anti-static carpet fiber shall contain antimicrobial additive and be treated with Scotchgard. Carpet weight shall be 1084 g/sq.m.

    a. Colors: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

A. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.

B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of foot grilles and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install foot grilles to comply with manufacturer's written instructions at locations indicated and with top of foot grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set foot-grille tops at height for most effective cleaning action. Coordinate top of foot-grille surfaces with doors that swing across grilles to provide clearance under door.

3.3 PROTECTION

A. Provide temporary filler of plywood or fiberboard in foot-grille recesses. Maintain protection until construction traffic has ended and Project is near Substantial Completion to add foot grilles.

END OF SECTION 124816

SECTION 134900 - RADIATION PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lead sheet, strip, and plate.
2. Lead-lined concrete masonry units.
3. Lead glass.
4. Lead-lined, hollow-metal doors and door frames.
5. Lead-lined flush wood doors.
6. Lead-lined, observation-window frames.
7. Informational signs.

B. Coordination: Refer to Shielding Report from Architect.

1.3 DEFINITIONS

A. Lead Equivalence: The thickness of lead that provides the same attenuation (reduction of radiation passing through) as the material in question under the specified conditions.

1. Lead equivalence specified for materials used in diagnostic x-ray rooms is as measured at 100 kV unless otherwise indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to radiation protection including, but not limited to, the following:

a. Sequence and schedule of radiation protection work in relation to other work.
b. Supplementary lead shielding at duct, pipe, and conduit penetrations of radiation protection.
c. Methods of attaching other construction and equipment to lead-lined finishes.
d. Notification procedures for work that requires modifying radiation protection.
e. Requirements for field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show layout of radiation-protected areas. Indicate lead thickness or lead equivalence of components. Show components and installation conditions not fully dimensioned or detailed in product data.

1. Show ducts, pipes, conduit, and other objects that penetrate radiation protection; include details of penetrations.
2. Show details of shielding doors and frames, including anchorage to and coordination with other work. Show locations of electrical conduit and boxes for connecting door operators, door operator switches, and door interlock switches.

a. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For observation windows, doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For shielding construction to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Provide materials and workmanship, including joints and fasteners that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.

1. Materials, thicknesses, and configurations must be based on radiation protection design prepared by Owner's radiation health physicist. This design is available as part of this specification.

B. Installer Qualifications: Fabricator of products.

C. Source Limitations: Obtain each type of radiation protection product from single source from single manufacturer.

D. Glazing: Comply with requirements in Division 08 "Glazing."

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to radiation protection including, but not limited to, the following:

a. Sequence and schedule of radiation protection work in relation to other work.
b. Supplementary lead shielding at duct, pipe, and conduit penetrations of radiation protection.
c. Methods of attaching other construction and equipment to lead-lined finishes.
d. Notification procedures for work that requires modifying radiation protection.
e. Requirements for field quality control.

G. Testing Agency Qualifications: Licensed by authorities having jurisdiction to perform radiation shielding surveys.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Lead-Lined Gypsum Panels: Neatly stack panels flat to prevent deformation.

B. Lead-Lined, Hollow-Metal Doors and Frames: Deliver doors and frames cardboard wrapped or crated to provide protection during delivery and storage. Inspect for damage on delivery. Minor damage may be repaired provided the refinished repair matches new work and is approved by Architect; otherwise, remove and replace damaged items as directed.

C. Lead-Lined Flush Wood Doors: Comply with manufacturer's written instructions.

1. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
2. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install radiation protection until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of openings for by field measurements before fabrication.

1.11 WARRANTY

A. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide materials and workmanship, including joints and fasteners that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.

1. Materials, thicknesses, and configurations indicated are based on radiation protection design prepared by Owner's radiation health physicist. This design is available to Contractor on request.

B. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in doors, door frames, window frames, penetration shielding, joint strips, film transfer cabinets, and other items located in lead-lined assemblies not less than that indicated for assemblies in which they are installed.

C. Lead Glazing: Unless otherwise indicated, provide lead equivalence not less than that indicated for assembly in which glazing is installed.

2.2 MANUFACTURERS

A. Basis of Design Manufacturers: Subject to compliance with requirements, provide products by Radiation Protection Products, Inc. or Architect approved equal.

1. Source Limitations: Obtain each type of radiation protection product from single source from single manufacturer unless otherwise indicated.

2.3 MATERIALS

A. Lead Sheet, Strip, and Plate: ASTM B 749, Alloy UNS No. L51121 (chemical-copper lead).

B. Borated Polyethylene: High-density polyethylene containing not less than 5 percent boron manufactured specifically for shielding.

C. Lead-Lined Concrete Masonry Units: Fabricated from two solid concrete units, complying with ASTM C 90 or ASTM C 129, separated vertically by a single sheet of lead permanently bonded or anchored between the two halves. Size lead sheets to provide a 1-inch (25-mm) overlap with adjacent units or provide supplemental lead to ensure uninterrupted protection.

1. Furnish special shapes as needed to maintain bond without cutting units.
2. Furnish lead wool for filling voids or joints.

D. Masonry Mortar: ASTM C 270, Type O, Proportion Specification.

E. Grout: ASTM C 476, with a slump of 200 to 280 mm as measured according to ASTM C 143/C 143M.

F. Lead Glass: Lead-barium, polished glass containing not less than 60 percent heavy metal oxides, including not less than 48 percent lead oxide by weight.

1. Safety Glass: Tempered lead glass.

a. Outer Ply: Clear float glass.
b. Interlayer: Clear polyvinyl butyral.
c. Inner Ply: Lead glass; thickness as needed to provide lead equivalence indicated.

G. Glazing Compounds, Gaskets, and Accessories: Factory installed per project requirements.

H. Accessories and Fasteners: Manufacturer's standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.

I. Asphalt Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

J. Asphalt Felt: ASTM D 226/D 226M.

2.4 LEAD-LINED, HOLLOW-METAL DOORS

A. General: Steel doors complying with NAAMM-HMMA 861, except with a single continuous sheet of lead of thickness not less than that required for partition in which door is installed extending from top to bottom and edge to edge, installed either between back-to-back stiffeners or between stiffeners and stop face of door.

1. Line inverted channels at top and bottom of doors with lead sheet of same thickness used in door and close with filler channels to provide flush top and bottom edges.
2. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining 25 mm.
3. Prepare doors to receive observation windows and louvers; cut and trim openings through doors in factory. Furnish removable stops for glazed openings.
4. Furnish lead-lined astragals for pairs of doors.
5. Factory fit doors to suit frame-opening sizes indicated with 1.5-mm clearance at heads and jambs and minimum clearance at bottom.
6. Factory-applied finishes are not covered by NAAMM-HMMA 861. Revise to suit product and Project.
7. Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating for factory-applied paint.

    a. Color and Gloss: As selected by Architect from manufacturer's full range.

B. Lead Door Louvers: Louvers with 20 percent free area made from formed-lead sheet or lead extrusions of not less than lead thickness required for door in which louver is installed. Fabricate louvers to be lightproof with fixed maze-type blades that maintain required lead equivalence at all points and in all directions. Fit and assemble louvers in doors at factory.

2.5 LEAD-LINED, HOLLOW-METAL DOOR FRAMES

A. General: Steel door frames complying with NAAMM-HMMA 861, except 1.7 mm thick, lined with lead sheet of thickness not less than that required for doors and walls where frames are used. Furnish with additional reinforcements and internal supports to adequately carry the weight of lead-lined doors. Install reinforcements and supports before installing lead lining.

1. Form lead sheet to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Fabricate lead lining wide enough to maintain an effective lap with lead of adjacent shielding.
2. Form lead shields around areas prepared to receive hardware.
3. Fabricate lead lining wide enough to maintain an effective 13 mm minimum overlap lap with lead of adjoining shielding.
4. Design lead-lined door frames to accommodate lead lining up to 13 mm thick.
5. Door Frame Supports: 57 mm steel angle iron.
6. Jamb Depth: 114 mm thru 355 mm, in 3 mm increments.
7. Jamb Profile: 50 mm.
8. Head Profile: 50 mm.
9. Frame Thickness: 14 gauge.

10. Factory-applied finishes are not covered by NAAMM-HMMA 861. Revise to suit product and Project.
11. Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating for factory-applied paint.

    a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.6 LEAD-LINED FLUSH WOOD DOORS

A. Lead-Lined Flush Wood Doors: Solid-core wood doors with lead lining, thickness not less than that required for partition in which door is installed.

1. Door Construction: Veneer face, five ply, bonded structural composite lumber core.
2. Lead Lining: One continuous sheet of lead extending from top to bottom and edge to edge, constructed in the core. Assemble lead lining and core with poured lead fasteners or steel bolts. Space fasteners not more than 38 mm from door edge and about 200 mm o.c. Countersink bolt heads and cover with lead.
3. Comply with Section 081416 "Flush Wood Doors" for matching grade, faces, veneer matching, performance grade, fabrication, finishing, and other requirements unless otherwise indicated.

B. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards.

1. Grade: Custom.

    a. Veneer Matching: As selected by Architect.
    b. Factory finish with stain and transparent catalyzed lacquer or conversion varnish.

2. Faces: Any closed-grain hardwood of mill option, for opaque finish.

C. Prepare doors to receive observation windows and louvers; cut and trim openings through doors in factory. Provide removable wood stops for glazed openings.

D. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining.

E. Furnish lead-lined astragals for pairs of doors.

F. Factory fit doors to suit frame openings indicated with 1.5-mm clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.

2.7 LEAD-LINED, OBSERVATION-WINDOW FRAMES

A. General: Fabricate from 1.1-mm thick, formed-steel sheet or 1.6-mm thick aluminum extrusions with mitered corners, welded or bolted with concealed fasteners.

1. Line with lead sheet formed to match frame contour, continuous in each jamb and across head and sill, lapping the stops, and fabricated wide enough to maintain an effective lap with lead of adjoining assemblies.
2. Construct so lead lining overlaps glazing material perimeter by at least 9.5 mm and furnish removable stops.

3. Form sill with an opening for sound transmission. Offset sound passage to make opening lightproof and to maintain required lead equivalence at all points and in all directions.

2.8 INFORMATIONAL SIGNS

A. Informational Signs: Comply with Division 10 "Signage" to match building signage.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Provide copy indicated or as directed.
3. Indicate lead equivalence in millimeters and heights of radiation protection in inches (millimeters).

B. Informational Signs: High-pressure-laminate engraving stock with contrasting face and core, machine engraved from master templates for accurately formed letters, numbers, and symbols.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Provide copy indicated or as directed.
3. Indicate lead equivalence in millimeters and heights of radiation protection in inches (millimeters).

C. Information Signage Locations:

1. Rooms Where the Level of Protection Is Uniform Throughout: Provide one sign for each room indicating lead equivalence of partitions, ceilings, floors, doors, and other portions of radiation protection enclosure. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height.
2. Rooms Where the Level of Protection Is Not Uniform Throughout: Provide one sign for each room with different lead equivalences in different locations. Indicate, in tabular form, lead equivalence of each wall, partition, ceiling, floor, door, and window. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height. Indicate where lead equivalence changes or is not continuous.
3. Rooms Where Some Partitions Are without Radiation Protection: Provide one sign for each partition that contains radiation protection and indicate its lead equivalence. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height.
4. Rooms Where Only the Door Has Radiation Protection: Provide one sign for each door indicating its lead equivalence.

2.9 DOOR AND DOOR FRAME FABRICATION

A. Hardware Preparation: Factory prepare doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 "Door Hardware."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive radiation protection, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF LEAD SHEETS IN CONCRETE FLOOR SLABS

A. Proceed with installation only after concrete surfaces are clean, dry, and free of depressions and sharp projections that could damage or penetrate lead sheet.

B. Apply a coat of asphalt mastic or paint to concrete surfaces before installing lead sheet.

C. Before installing floor lead sheet, place lead strips not less than 175 mm wide under the base of vertical wall protection. Extend lead strips approximately 3 inches 75 mm into the shielded room area.

D. Lead Sheet, 3 mm Thick or Less: Install in a single layer with a 50 mm minimum lap at joints.

E. Lead Sheet More Than 3 mm Thick: Install in two or more layers with a 50 mm minimum lap at joints, or in a single layer with joints butted and covered with a 100 mm wide lead strip of same thickness.

F. Extend lead sheet at least 300 mm beyond radiation protection in walls of room.

G. In floor slabs above shielded rooms where lead sheet is indicated, extend lead sheet at least 300 mm beyond radiation protection in walls of room below.

H. At door openings, extend lead sheet at least 300 mm beyond radiation protection in walls and at least 300 mm beyond door opening on both sides except where lead-lined thresholds are provided.

I. After installation, apply two coats of asphalt coating on top surface of lead sheet and protect from damage until concrete topping is placed.

3.3 INSTALLATION OF LEAD-LINED CONCRETE MASONRY UNITS

A. Lay units in running bond, using methods recommended in writing by concrete masonry unit manufacturer.

B. Cut units, as needed, without disturbing bond between lead and concrete, and without reducing required lapping margin or shielding qualities.

C. Blocks Designed to Have Lead Laps at Joints: Lay units with tight lead laps without soldering or burning.

D. Blocks Designed to Have Lead Bars in Joints: Lay units with lead bars, of thickness not less than that required in block, in each horizontal and vertical joint. Position bars directly adjacent to lead lining with bars overlapping lead lining at least twice the thickness of lead lining, but not less than 13 mm.

E. Mortar Joints: Lay units with 13-mm solidly filled mortar joints. Keep lead laps free of intervening mortar. Cut joints flush with face of units.

F. Wraparound Metal Frames: Extend units into frame openings with lead lining projecting into rabbets of frames to effectively lap with lead frames or frame linings at least 25 mm.

G. Pipe and Conduit Chases: Where pipe and conduit chases occur within blocks, faces can be removed from one side to permit installation. Where necessary to remove lead lining for pipe and conduit installation, install continuous lead sheet and overlap adjoining lead protection at least 25 mm. Fill voids around pipe and conduit chases with mortar, finished flush with face of partition. Do not locate pipe and conduit chases directly opposite each other in same partition.

3.4 INSTALLATION OF LEAD-LINED DOORS AND DOOR FRAMES

A. Install lead-lined steel doors and door frames according to manufacturer's written installation instructions.

B. Install lead-lined wood doors according to manufacturer's written installation instructions.

C. Glazing: Factory glazed.

D. Frames: Comply with HMMA 840 unless otherwise indicated. Except for frames located in existing walls or partitions, place frames before constructing walls. Set frames accurately in position, plumb, and brace securely until permanent anchors are set.

1. Provide three anchors per jamb, located adjacent to hinge on hinge jamb and at corresponding heights on strike jamb.
2. In masonry construction, use wire or T-strap anchors and apply a coat of asphalt mastic or paint to lead lining where lead comes in contact with masonry or grout.
3. In metal stud construction, use wall anchors attached to studs with screws.
4. In wood stud construction, use strap anchors attached to studs with screws.

E. Lap lead lining of frames over lining in walls at least 25 mm.

F. If retaining one of two paragraphs at beginning of article referencing Sections for lead-lined steel or wood doors, delete first paragraph below.

G. Install doors in frames level and plumb, aligned with frames and with uniform clearance at each edge.

H. Line astragals with lead sheet.

I. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Division 08 "Door Hardware" for other installation requirements.

J. Touch up damaged finishes with compatible coating after sanding smooth.

K. Operation: Rehang or replace doors that do not swing or operate freely. Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.5 INSTALLATION OF LEAD-LINED OBSERVATION WINDOWS

A. Install observation windows according to manufacturer's written installation instructions.

1. Apply a coat of asphalt mastic or paint to lead lining in frames where lead comes in contact with masonry or grout.

B. Install windows level, plumb, square, true to line, and anchored securely in place to structural support.

C. Install leaded side of frame on radiation side of wall. Lap lead lining of frames over lining in walls at least 25 mm.

D. Glazing: Factory glazed.

3.6 INSTALLATION OF PENETRATING ITEMS

A. At penetrations of lead linings, provide lead shields to maintain continuity of protection.

B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.

C. Secure shields at penetrations using adhesive or wire ties but not penetrating fasteners unless indicated on Drawings.

D. Outlet Boxes and Conduit: Cover or line with lead sheet lapped over adjacent lead lining at least 25 mm. Wrap conduit with lead sheet for a distance of not less than 250 mm from box.

E. Duct Openings: Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition/ceiling equal to three times the largest opening dimension. Lap lead sheet with adjacent lead lining at least 25 mm.

F. Piping: Unless otherwise indicated, wrap piping with lead sheet for a distance of not less than 250 mm from point of penetration.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections after radiology equipment has been installed and placed in operating condition.

B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.

C. Prepare test and inspection reports.

3.8 PROTECTION

A. Lock radiation-protected rooms once doors and locks are installed, and limit access to only those persons performing work in the rooms.

END OF SECTION 134900

SECTION 142400 – ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electric traction passenger elevators.

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:

1. Signal and operating fixtures, operating panels and indicators.
2. Cab design, dimensions and layout.
3. Hoistway-door and frame details.
4. Electrical characteristics and connection requirements.
5. Expected heat dissipation of elevator equipment in hoistway (BTU).
6. Color selection chart for Cab and Entrances.

B. Shop Drawings:

1. Include layout drawings. Include the following:

a. Large-scale layout of car-control station.
b. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
c. Car, guide rails, buffers and other components in hoistway.
d. Maximum rail bracket spacing.
e. Maximum loads imposed on guide rails requiring load transfer to building structure.
f. Clearances and travel of car.
g. Clear inside hoistway and pit dimensions.
h. Location and sizes of access doors, hoistway entrances and frames.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and control closet layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Elevator must be installed by manufacturer or an authorized representative who is trained and approved by the manufacturer.

B. The Manufacturer/Installer of the elevator shall have minimum of 10 years in business fabricating elevator equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off the ground, under cover, and in a dry location.

1.8 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: 12-months from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of twelve (12) months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

B. The elevator control system must: Provide in the controller the necessary devices to run the elevator on inspection operation. Provide on top of the car the necessary devices to run the elevator in inspection operation. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing. Provide the means from the controller to reset the governor over speed switch and trip the governor. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed. Provide the means from the controller to reset elevator earthquake operation.

C. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:

1. Remotely diagnose elevator issues with a remote team of experts
2. Remotely return an elevator to service
3. Provide real-time status updates via email
4. Remotely make changes to selected elevator functions including:

a. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
b. Improve passenger experience**:** Extend door open times to meet ADA requirements, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide product by Otis Elevator Co.; Gen2 or by one of the following with a comparable product:

1. Schindler Elevator Corporation
2. Thyssen Krupp
3. KONE
4. Architect Approved Equivalent.

2.2 ELEVATORS

A. Elevator Description

1. Rated Capacity: 1588 kg.
2. Opening: Front.
3. Rated Speed: 1.8 m/s.
4. Clear Inside Shaft Dimensions: See Drawings.
5. Travel Distance: See Drawings.
6. Operation: Selective-collective automatic operation.
7. Cab Height: 2430 mm.
8. Entrance Width and Type: 1400 mm center-open doors
9. Entrance Height: 2130 mm door height
10. Controller Location: In machine room, adjacent to hoistway on top floor

    a. Express Priority Service.
    b. Automatic Rescue Operation.
    c. Reset elevator earthquake operation.
    d. Firefighter’s In-Car Operating Instruction.

11. Cab Finishes:

    a. Car and Doors Finish: Stainless steel.
    b. Handrails: Flat stainless steel with standoff in satin stainless steel.
    c. Ceiling Type: Rubberwood with LED perimeter lighting.
    d. Car Flooring: Resilient rubber flooring.

12. Hall Lantern – show both direction and location on all floors.
13. Provide hooks for protective pads in all cars and two complete set(s) of full-height protective pads.

2.3 GENERAL PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASMEA17.1.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICCA117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined per ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk in ASME A17.1/CSA B44.

D. Control: The elevator controller shall be of a non-proprietary design that can be serviced by at least three local contractors.

E. Electrical Characteristics:

1. Main Power Supply: 480 Volts + or - 5% of normal, 3-Phase, to suit available power.
2. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.

F. Machine Location: Inside the hoistway at the top of the hoistway.

G. Controller Location: Machine-Room-less Controller(s) in the front wall on the same side as the counterweight, located at the top landing.

H. Car Performance:

1. Car Speed: $\pm$ 3 % of contract speed under any loading condition or direction of travel.
2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (Code required).
3. Ride Quality:

    a. Vertical Vibration (maximum): 20 milli-g
    b. Horizontal Vibration (maximum): 12 milli-g
    c. Vertical Jerk (maximum): 4.59 1.0 ft./ sec^3
    d. Acceleration/Deceleration (maximum): 2.62 ft./ sec^2
    e. In Car Noise: 55 – 60 dB(A)
    f. Stopping Accuracy: 9 mm. max, 6 mm. Typical
    g. Re-leveling Distance: 12 mm.

I. Door Control Features:

1. Door protection shall consist of a three dimensional, multi-beam array projecting across the car door opening.
2. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
3. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
4. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
5. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy. Coordinate nudge mode requirement during normal operations with Owner.

J. Automatic Evacuation

1. For all elevators, when the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. If the car is at a floor when the power fails, it remains at that floor, opens its doors, and shuts down. If the car is between floors, it is raised or lowered to the first available landing, opens its doors, and shuts down.

K. Hoistway Entrances

1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sills: All shall be nickel silver finish.
3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
4. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible per NFPA252 or UL10B.
5. Entrance marking plates: Entrance jambs shall be marked with 101 mm x 101 mm plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
6. Sight Guards: sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel and gold satin doors.

L. Hoistway Access Switches: Provide key-switch at all floors in entrance jamb in compliance with building code.

M. Sleep mode operation for LED ceiling lights and car fan to be provided at elevator manufacturer ceilings.

2.4 ELEVATOR EQUIPMENT COMPONENTS

A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation.

1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed to be physically segregated from the rest of the controller.
3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity per the EN 12016: “EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity”
5. Controller shall be located inside the wall next to the top landing entrance frame. Emergency access shall be provided through an access panel in the entrance frame secured by a key lock.
6. A separate control room or cabinet should not be required.
7. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

B. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.

C. Governor: The governor shall be a tension type car-mounted governor.

D. Buffers, Car and Counterweight: Compression spring type buffers to comply with building code.

1. Hoistway Operating Devices:

a. Emergency stop switch in the pit.
b. Terminal stopping switches.

E. Positioning System: Consists of an encoder, reader box, and door zone vanes.

F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.

G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. All driving sheaves and deflector sheaves should have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance based technology must be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.

H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.

I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.

J. Car Components:

1. Car frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.
2. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
3. Fan: A two-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
4. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
5. Guides: The car shall have roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom. Size roller guides diameter per manufacturer recommendations.
6. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.
7. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.
8. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.
9. General: Provide enameled-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
10. Provide standard railings complying with ASMEA17.1 on car tops where required by ASMEA17.1.

K. Signal Devices and Fixtures

1. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2. Car Operating Panel: Shall be satin stainless steel. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:
3. The car operating panel shall be equipped with the following features:

    a. Raised markings and Braille to the left-hand side of each push-button.
    b. Car Position Indicator at the top of and integral to the car operating panel. Door open and door close buttons.
    c. Inspection key-switch.
    d. Elevator Data Plate marked with elevator capacity and car number.
    e. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
    f. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
    g. In car stop switch- key.
    h. Firefighter's hat.
    i. Firefighter's Phase II Key-switch.
    j. Call Cancel Button.
    k. Please Exit Symbol: provided with emergency hospital service, Seismic Zones ≥2 or express priority in the hall.

4. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
5. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
6. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation.
7. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the wall. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel**.**

    a. Vandal-Resistant, Flush satin stainless steel button with blue LED illuminating center jewel.

8. Card Reader Provision.
9. Emergency (standby) Power key-switch: Manual selection of each elevator in normal operation after automatic return in standby power operation has been initiated.

2.5 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A240M, Type 304.

E. Stainless-Steel Bars: ASTM A 276, Type 304.

F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

G. Aluminum Extrusions: ASTM B 221, Alloy 6063.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 3 mm.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

H. Locate hall signal equipment for elevators as follows unless otherwise indicated:

1. Place hall lanterns either above or beside each hoistway entrance.
2. Mount hall lanterns at a minimum of 1828 mm above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASMEA17.1 and by governing regulations and agencies.

3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400

SECTION 21 10 00 - WATER-BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Specification section 22 05 00 “Common Work Results For Plumbing” applies to this section. All general provisions within are to be followed, unless otherwise superseded by this specification section specific to the Fire Protection System

1.2 SUMMARY

A. This Section includes fire-suppression piping and equipment for the following building systems:

1. Wet-pipe fire-suppression system, including piping, valves, specialties, and accessories

1.3 DEFINITIONS

A. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.

B. Hose Station: Hose connection, fire hose rack, and fire hose.

C. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Design piping and hose system[**s**] according to the following and obtain approval from authorities having jurisdiction.

1. Residual pressure of 60 psig with 100 gpm flowing. Location of flowing hose station at furthest run.

1.5 SUBMITTALS

A. General: See Section 21 05 00 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Submit product data, flow test report and drawings with hydraulic calculations in one single package prior to installation.

C. Product Data: For the following:

1. Pipe and fitting materials and methods of joining for piping.
2. Pipe hangers and supports.
3. Valves, including specialty valves, accessories, and devices.
4. Backflow Preventers: Include pressure drop curve and maintenance and testing information.
5. Hose stations. Include size, type, and finish of hose connections; type and length of fire hoses; finish of fire hose couplings; type, material, and finish of nozzles; and finish of rack.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Maintenance Data: For each type of piping and specialty to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and that comply with other requirements indicated.

B. Standpipe and Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

C. To ensure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.

D. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
1. NFPA 14, "Standpipe and Hose Systems."
2. NFPA 24, “Installation of Private Fire Service Mains and Their Appurtenances.”

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

A. Ductile-Iron Pipe: AWWA C151, mechanical-joint type; with cement-mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.

B. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Schedule 40. Hot dip galvanized where indicated.

C. Steel Pipe, NPS 2-1/2 and Larger: ASTM A 135 or ASTM A 795, Grade A, Schedule 10 for NPS 5-inch and Smaller; NFPA specified wall thickness for NPS 6-inch and NPS 8-inch. Hot dip galvanized where indicated.

D. Copper Tube: ASTM B 88, Type K water tube, drawn temper.

2.2 PIPE AND TUBE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical Joint Piping System:

a. Anvil Gruvlok.
b. Grinnell Grooved Products.
c. Victaulic Co.

B. Ductile-Iron Fittings: ASTM A 536, ductile-iron casting complying with AWWA pipe size; with ends factory grooved according to AWWA C606. Include cement-mortar lining and seal coat according to AWWA C104 or epoxy, interior coating according to AWWA C550.

C. Cast-Iron Flanges: ASME B16.1.

D. Cast-Iron Threaded Fittings: ASME B16.4.

E. Steel Threaded Couplings: ASTM A 865.

F. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

G. Steel Flanges and Flanged Fittings: ASME B16.5.

H. Steel Pipe Grooved Mechanical Joint Fittings: Victaulic fittings or equal by Anvil Gruvlok or Grinnell Grooved Products, UL-listed and FM-approved, ASTM A 536 Grade 65-4542 ductile iron or ASTM A 106, Grade B forged steel; with ends factory grooved to match specified coupling.

I. Cast-Bronze Flanges: ASME B16.24.

J. Copper Tube Grooved Mechanical Joint Fittings: Victaulic fittings or equal by Anvil Gruvlok or Grinnell Grooved Products, UL listed and FM-approved, ASTM B 75, copper tube or ASTM B 584, bronze castings with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).

2.3 JOINING MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical Joint Piping System:

a. Anvil Gruvlok.
b. Grinnell Grooved Products.
c. Victaulic Co.

B. Ductile-Iron, Mechanical Grooved Joint Couplings: Victaulic Style 307, Style 31 or equal by Anvil Gruvlok or Grinnell Grooved Products, UL listed and FM-approved AWWA C606, for ductile-iron pipe dimensions. Include ASTM A 536, ductile-iron housing, synthetic rubber gaskets, and steel bolts and nuts.

C. Steel Pipe, Grooved Mechanical Joint Coupling: Victaulic Style 009H rigid couplings for 1-1/4" through 4" sizes, Style 005 rigid couplings for 6" through 8" sizes; and Style 177 or 75 flexible couplings or equal by Anvil Gruvlok or Grinnell Grooved Products; UL listed and FM-approved, ductile iron housing conforming to ASTM A-536, Grade 65-45-12; Grade "E" or "EHP" EPDM gaskets.

D. Copper Pipe, Grooved Mechanical Joint Coupling: Victaulic Style 607 rigid coupling or equal by Anvil Gruvlok or Grinnell Grooved Products, UL listed and FM-approved, ductile iron housing conforming to ASTM A-536, Grade 65-45-12; Grade "EHP" gaskets.

E. Ductile-Iron, Flanged Joints: AWWA C115, ductile-iron or gray-iron pipe flanges, rubber gaskets, and steel bolts and nuts.

F. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 POLYETHYLENE ENCASEMENT

A. Polyethylene Encasement for Ductile-Iron Piping: ASTM A 674 or AWWA C105, film, 0.008-inch minimum thickness, tube or sheet.

2.5 FIRE-PROTECTION-SERVICE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Indicator Posts and Indicator-Post, Gate Valves:

a. American Cast Iron Pipe Co.; Waterous Co.
b. McWane, Inc.; Clow Valve Co. Div.
c. McWane, Inc.; Kennedy Valve Div.
d. Nibco, Inc.
e. Stockham Valves & Fittings, Inc.
f. Victaulic Co.

2. Indicator Valves:

a. McWane, Inc.; Kennedy Valve Div.
b. Milwaukee Valve Co., Inc.
c. Nibco, Inc.

d. Tyco Fire Suppression & Building Products
e. Victaulic Co.

3. Fire-Protection-Service Valves:

a. McWane, Inc.; Kennedy Valve Div.
b. Nibco, Inc.
c. Stockham Valves & Fittings, Inc.
d. Tyco Fire Suppression & Building Products
e. Victaulic Co.

B. General: UL listed and FM approved, with minimum 175-psig nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

C. Gate Valves, NPS 2 and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

D. Gate Valves, NPS 2-1/2 and Larger: UL 262, ductile iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

E. Gate Valves, NPS 2-1/2 and Larger, Working Pressure over 175 psi: UL 262, ductile iron body, bronze mounted, resilient wedge, OS&Y, brass rising stem, grooved by grooved ends, or grooved by flanged ends, 250 psi.

F. Indicating Valves, NPS 2 and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded or grooved ends; integral indicating device and prewired, 115-V ac, two-circuit, supervisory switches where required.

G. Indicating Valves, NPS 2-1/2 and Larger: UL 1091; butterfly type, ductile iron body with grooved ends; integral indicating devices with weatherproof actuator and prewired, 115-V ac, two-circuit, supervisory switches.

H. Indicator-Post, Gate Valves: UL 262, ductile iron body, bronze mounted, solid-wedge disc, and nonrising stem with operating nut and flanged ends.

I. Indicator-Post, Gate Valves, Working Pressure over 175 psi: UL 262, ductile iron body, bronze mounted, resilient wedge, brass nonrising stem with cast iron wall post indicator, grooved by grooved ends or flanged by grooved ends, 250 psi.

J. Wall Indicator Posts: UL 789, FM approved, horizontal, wall type, cast-iron body, with windows for target plates that indicate valve position, extension rod and coupling, locking device, hand wheel operator, and red enamel finish.

1. Operation: Operating wrench.

K. Swing Check Valves, NPS 2 and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

L. Swing Check Valves, NPS 2-1/2 and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

M. Spring-Loaded Check Valves, NPS 2 and Larger: UL 312, ductile iron body, stainless steel or EPDM coated ductile iron disc, stainless steel spring, plated nickel or welded-in nickel seat, grooved ends.

2.6 HOSE STATIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Elkhart Brass Mfg. Co., Inc.
2. Fire-End and Croker Corp.
3. Guardian Fire Equipment, Inc.
4. Smith Industries, Inc.; Potter-Roemer Div.

B. Description: UL 47, semiautomatic hose stations. Include brass, rack nipple; hose rack; and the following features:

1. Valves: UL 668, 300-psig minimum pressure rating, 90- degree angle pattern hose valve with female NPS inlet and outlet, unless otherwise indicated.

    a. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.

2. Threads and Gaskets: NFPA 1963 and matching local fire department threads.
3. Flow-Restricting Devices: NPS 1-1/2 brass, adjustable for NPS 1-1/2 fire hose inlet.
4. Fire Hose: NFPA 1961 and UL 219, lined fire hose with couplings, gaskets, and nozzle. Include the following fire hose materials:

    a. Jacket: Natural, synthetic, or combination of threads.
    b. Lining: Rubber, plastic, or combination of compounds.
    c. Cover: Rubber, plastic, or combination of compounds.

5. Nozzles: UL 401.
6. Drain Valves: UL 1726.
7. Mountings: Pipe clamp or wall bracket for freestanding units.
8. Mountings: Pipe escutcheon for cabinet-mounted units.

C. NPS 2-1/2 by NPS 1-1/2 Hose Stations: NPS 2-1/2 hose valve; NPS 2-1/2 by NPS 1-1/2 reducer adapter; hose rack with water-retention device and pins for folded, NPS 1-1/2 lined hose; NPS 1-1/2 lined hose with swivel inlet coupling and nozzle; and reducer adapter spanner wrench.

1. Hose-Rack Finish: Polished chrome-plated.
2. Hose Valve and Trim Finish: Rough chrome-plated.
3. Fire Hose: Lined, [**50**][**75**][**100**]-foot length.
4. Nozzle: Brass, adjustable from shutoff to fog spray or straight stream.

D. NPS 1-1/2 Hose Stations: NPS 1-1/2 hose valve; hose rack with water-retention device and pins for folded, NPS 1-1/2 lined hose; and NPS 1-1/2 lined hose with swivel inlet coupling and nozzle.

1. Hose-Rack Finish: Polished chrome-plated.
2. Hose Valve and Trim Finish: Rough chrome-plated.
3. Fire Hose: Lined, [**50**][**75**][**100**]-foot length.
4. Nozzle: Brass, adjustable from shutoff to fog spray or straight stream.

E. NPS 2-1/2 and NPS 1-1/2 Hose Stations: NPS 2-1/2 hose valve with male threaded outlet, cap, and chain and NPS 1-1/2 hose valve; hose rack with water-retention device and pins for folded, NPS 1-1/2 lined hose; and NPS 1-1/2 lined hose with swivel inlet coupling and nozzle.

1. Hose-Rack Finish: Polished chrome-plated.
2. Hose Valve and Trim Finish: Rough chrome-plated.
3. Fire Hose: Lined, [**50**][**75**][**100**]-foot length.
4. Nozzle: Brass, adjustable from shutoff to fog spray or straight stream.

F. NPS 1-1/2 Hose-Reel Hose Stations: NPS 1-1/2 hose valve; hose reel with water-retention device and pins for NPS 1-1/2 lined hose; and NPS 1-1/2 lined hose with swivel inlet coupling and nozzle.

1. Hose-Rack Finish: Red enamel.
2. Hose Valve and Trim Finish: Rough chrome-plated.
3. Fire Hose: Lined, [**50**][**75**][**100**]-foot length.
4. Nozzle: Brass, adjustable from shutoff to fog spray or straight stream.

2.7 BACKFLOW PREVENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ames Co., Inc.
2. CMB Industries, Inc.; Febco Backflow Preventers.
3. Conbraco Industries, Inc.
4. Mueller Co.; Hersey Meters Div.
5. Sparco, Inc.
6. Watts Industries, Inc.; Water Products Div.
7. Zurn Industries, Inc.; Wilkins Div.

B. General: ASSE standard, backflow preventers.

1. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
2. NPS 2-1/2 (DN 65) and Larger: Bronze, cast-iron, steel, or stainless steel body with flanged ends.

    a. Interior Lining: AWWA C550 or FDA approved, epoxy coating for backflow preventers having cast-iron or steel body.

3. Interior Components: Corrosion-resistant materials.
4. Exterior Finish: Polished chrome plate if used in chrome-plated piping system.
5. Strainer: On inlet, if indicated.

C. Double-Check Backflow Prevention Assemblies: ASSE 1015, suitable for continuous pressure application. Include shutoff valves on inlet and outlet, and strainer on inlet; test cocks; and two positive-seating check valves. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

D. Double-Check Detector Assembly Backflow Preventers: ASSE 1048, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; two positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to other divisions for excavating, trenching, and backfilling.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING APPLICATIONS

A. Do not use welded joints with galvanized steel pipe.

B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

C. Piping between Fire Department Connections and Check Valves: Use galvanized, Schedule 40 steel pipe with grooved ends with mechanical grooved joint system.

D. Underground Service-Entrance Piping: Use ductile-iron pipe with mechanical grooved joint system.

E. Service-Entrance Piping Inside Building: If backflow preventer is not within 5 feet of underground service-entrance piping, use Type K hard drawn copper tubing upstream of backflow preventer. Do not use steel pipe on municipal water system upstream of backflow preventer.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13 and NFPA 14.

   a. Shutoff Duty: Use gate valves.

2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13 and NFPA 14.

   a. Shutoff Duty: Use gate, ball, or butterfly valves.

3.5 JOINT CONSTRUCTION

A. Ductile-Iron-Piping, Mechanical Grooved Joint System: Use ductile-iron pipe with radius-cut-grooved ends; mechanical grooved joint fittings and couplings. Piping shall be grooved in accordance to mechanical grooved joint system manufacturer’s recommendations. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

B. Steel-Piping, Mechanical Grooved Joint System: Use steel pipe with cut or roll-grooved ends; steel pipe mechanical grooved joint fittings and couplings. Piping shall be grooved in accordance to mechanical grooved joint system manufacturer’s recommendations. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

C. Copper-Tubing, Mechanical Grooved Joint System: Use copper tube with roll-grooved ends; copper pipe mechanical grooved joint fittings and couplings. Piping shall be grooved in accordance to mechanical grooved joint system manufacturer’s recommendations. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

D. A factory trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools and installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

E. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to Division 23 Section "Common Mechanical Materials and Methods" for dielectric fittings.

3.6 SERVICE-ENTRANCE PIPING

A. Connect piping to water-service piping of size and in location indicated for service entrance to building. Refer to other divisions for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.7 PIPING INSTALLATION

A. Refer to Division 23 Section "Common Mechanical Materials and Methods" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground service-entrance piping according to NFPA 24 and with restrained joints.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

G. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.

H. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

3.8 HOSE-STATION INSTALLATION

A. Install freestanding hose stations for access and minimum passage restriction.

B. Install NPS 1-1/2 hose-station valves with flow-restricting device, unless otherwise indicated.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow- restricting device, unless otherwise indicated.

D. Install freestanding hose stations with support or bracket attached to standpipe or substrate.

E. Install wall-mounting, rack-type hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Cabinets are specified in Division 10 Section "Fire-Protection Specialties."

F. Install hose-reel hose stations on wall with bracket attached to substrate.

3.9 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14

3.10 FIELD QUALITY CONTROL

A. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

B. Report test results promptly and in writing to Architect and Authorities Having Jurisdiction.

3.11 START-UP PROCEDURES

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that potable-water supplies have correct types of backflow preventers.

D. Fill pipes with water.

E. Verify that hose connections are correct type and size.

F. Verify that hose stations are correct type and size.

G. Adjust operating controls and pressure settings.

H. Coordinate with fire-pump tests. Operate as required.

3.12 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. Schedule demonstration with Owner with at least seven days' advance notice.

END OF SECTION 21 10 00

SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes general and supplementary conditions specifically applicable to Division 22, in addition to Division 1.

B. This Section includes the following basic mechanical materials and methods to complement other Division 22 Sections.

1. Submittals.
2. Coordination Drawings.
3. Record Documents.
4. Maintenance Manuals.
5. Piping materials and installation instructions common to most piping systems.
6. Concrete base construction requirements.
7. Escutcheons.
8. Dielectric fittings.
9. Flexible connectors.
10. Mechanical sleeve seals.
11. Nonshrink grout for equipment installations.
12. Field-fabricated metal equipment supports.
13. Installation requirements common to equipment specification sections.
14. Rough-ins.
15. Mechanical demolition.
16. Mechanical Installations.
17. Cutting and patching.
18. Touchup painting and finishing.

1.3 GENERAL REQUIREMENTS

A. Intent:

1. The intent of the Contract Documents is for the Contractor to include all work necessary for the complete plumbing systems, tested and ready for operation.
2. By submitting a proposal, the Contractor represents that it has made a thorough examination of the site, of the work, and all existing conditions and limitations, and that it has examined the Contract Documents in complete detail and has determined beyond

doubt that the drawings, specifications, and existing conditions are sufficient, adequate and satisfactory for the construction of the work under the Contract.

3. Where minor adjustments of the work are necessary for purposes of fabrication or installation of items, or resolution of conflicts between items within the intent of the Contract Documents, the Contractor shall make such adjustments with no added compensation. Where such adjustments affect functional or aesthetic design of the work, they shall first be submitted to the Architect for review and approval.

B. Conditions:

1. Conform to all Bidding Requirements, General Conditions, and Amendments to the General Conditions, Supplementary Conditions and Special Conditions and General Requirements, Division 1, which govern the work specified herein.
2. The Contractor is obligated to comply with the above in addition to the requirements of this Section.
3. Modifications by this Section do not nullify any other portions of the above referenced conditions.

C. Make complete plumbing installation, connecting to all equipment shown on the plans, or called for in the specifications.

D. Plans and Specifications: Plans and specifications shall be taken together.

1. Contractor shall provide all equipment, materials, and work shown on the plans and/or called for in these specifications.
2. Provide work specified and not indicated on plans, or work indicated on plans and not specified, as though mentioned in both.
3. When discrepancies or conflicts occur within the documents, the Architect shall determine which takes precedence and the Contractor shall perform the selected requirement without additional cost.

E. Plumbing Drawings:

1. Plumbing drawings do not attempt to show all aspects of building construction, which will affect the installation of plumbing systems. The plumbing drawings are diagrammatic and do not intend to show all offsets and fittings that may be required for a complete installation. Locations of equipment, pipes, valves, traps, etc. shown on the drawings, shall be followed as closely as conditions will permit. Review all project drawings, including, but not limited to, architectural, structural and electrical drawings; and coordinate with all trades involved so there is no conflict with work of other trades and so Owner secures best arrangement of work consistent with use of space.
2. Verify exact distances between points shown of drawings by actual measurement at site, as no extra cost will be allowed for differences between actual measurements and scaled measurements.
3. Changes in design, configuration, or location of equipment, piping, advisable in the opinion of Contractor, shall be submitted to Architect for approval before proceeding with work, with written assurance from other trades that such changes will not interfere with their installation, nor cause any extra cost on their part. Such changes shall be made at no additional cost to Owner.

4. Check location of all work of all trades and avoid interferences. Special attention is called to the following items; conflicts shall be reported to Architect for decision and direction:

   a. Exact location of outlets shown on architectural details.
   b. Location of suspended ceilings.
   c. Location of ducts, grilles, pipes, and other mechanical equipment so electrical outlets are clear of these items and in proper relation to same.

1.4 CODES, PERMITS AND INSPECTIONS

A. Codes: Work shall be installed as a minimum in conformity with applicable local ordinances and statutes. Standards and sizes, which exceed preceding requirements, shall be installed as drawn or specified. Nothing in the specifications shall be construed to permit deviation to less than the requirements of governing codes. Contractor is not relieved from furnishing and installing work shown or specified which may be beyond requirements of ordinances, laws, regulations, and codes.

B. Permits, Fees and Inspections:

1. Contractor shall arrange and pay for all permits, fees, and inspections required in connection with this installation. The Contractor shall present the Owner with properly signed certificates of final inspection before the work will be accepted.
2. Contractor shall call for all inspections by local building official(s) when they become due, and shall not cover any work until approved by these governing authorities.
3. Contractor shall make all arrangements with utility companies for water, steam, gas and drainage services, etc., associated with the work and include required payments for meters, piping, services, connection charges and materials furnished and installed by utility companies. Work and materials shall be in strict accordance with rules of respective authorities.

1.5 WORK INCLUDED

A. Work under this division shall include providing all materials, labor, equipment, tools, appliances, hoisting, scaffolding, supervision, and overhead for the proper execution and completion of the plumbing work.

B. Should these specifications or references made therein fail to specify adequately an item of equipment or material required for proper completion of the work in accordance with present day practice, this deficiency shall not relieve Contractor from furnishing and installing same. Call such omissions to attention of Architect and use such equipment or material as approved by Architect.

C. All new equipment and products as noted in Part 2 of each section shall be installed as per manufacturer's recommendations.

D. Provide all additional piping, caps, and valves not shown on drawings, to maintain fully operational systems during the project at no additional cost to the owner.

1.6 WORKMANSHIP

A. This Contractor shall provide completed systems with a neat and finished appearance. If, in the judgment of the Architect, any portion of the work has not been performed in a workmanlike manner or is left in a rough, unfinished state, this Contractor will be required to remove, reinstall or replace same and patch and paint surrounding surfaces in a manner acceptable to the Architect, without increase in cost to the Owner.

1.7 SUBMITTALS, GENERAL REQUIREMENTS

A. General: Follow the procedures for submittals or as described herein and specified in Division 1.

B. General Requirements for Division 22 Submittals: Provide the following submittals as indicated in each Division 22 section. Additional submittal requirements may be included in the individual sections.

1. Product Data: Submit manufacturer's product data for the items listed in the individual Division 22 sections. Product data shall demonstrate compliance with all specified features and requirements. Submittals for equipment shall include, but not be limited to, data indicating equipment capacity meets the indicated values at specified conditions, equipment drawings indicating all dimensions, connection information, service space requirements, recommended piping and/or wiring diagrams, installation details and extended warranties either offered by equipment manufacturer or required by specifications.
2. Shop Drawings: Submit Contractor prepared drawings of Contractor fabricated plumbing systems. Drawings shall be prepared using Computer Aided Design (CAD) software unless indicated otherwise. Drawings shall show exact location of equipment and piping, each section of shop fabricated pipe and location of field joints, supports and building attachments.
3. Reports and Certificates: Indicate and interpret test results for compliance with performance requirements. Provide performance certificates.
4. Operation and Maintenance Data: Submit proposed Division 22 Operation and Maintenance materials for approval prior to inclusion in the comprehensive final bound edition. See Article in this section on Operation and Maintenance Manuals for materials required to be included.

C. Format: Provide submittals arranged with numerical index and tabs as an electronic PDF document. All product data shall be submitted complete by system, partial submittals are not acceptable and may be returned unreviewed. Systems are defined here as plumbing systems and fire protection system. Reference submittals, including title and location of project, Architect, Contractor, submission date, and specification paragraph number to indicate clearly the location, service, equipment identification numbers as shown on drawings, and function of each particular item. Where manufacturers' catalogs, pamphlets, or data sheets are submitted in lieu of prepared shop drawings, such submissions shall indicate specifically the item for which approval is required in red ink, and submissions showing general information only are not acceptable.

D. Submittals not in conformance to above paragraphs will be returned unreviewed.

1.8 COORDINATION DRAWINGS

A. Detail major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

1. Planned piping layout, including valve and specialty locations and valve-stem movement.
2. Clearances for installing and maintaining insulation.
3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
4. Equipment and accessory service connections and support details.
5. Other systems installed in same space as plumbing systems.
6. Exterior wall and foundation penetrations.
7. Ceiling and wall-mounted access doors and panels required to provide access devices.
8. Sizes and location of required concrete pads and bases.
9. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
10. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.9 SUBSTITUTIONS

A. Substitutions will only be considered after project award. No substitutions will be considered during bid and/or negotiation periods.

B. In all cases in this specification where an article is followed by the words "or equal," the Engineer is the sole judge of the quality of the proposed substitution.

C. When the Engineer approves a substitution, the approval is given with the understanding that the Contractor guarantees the article or material substituted to be equal to or better in every respect than the article or material specified. The Contractor shall also assume complete responsibility that the article or material will fit the job as far as space, access, and servicing requirements.

D. Where several materials are specified by name for one use, select for use any of those so specified subject to compliance with specified requirements.

E. Whenever item or class of material is specified exclusively by detail specification, trade name, manufacturer's name or by catalog reference, use only such item, unless written approval is given. Submit written requests in accordance with Division 1 substitution requirements.

F. Make no substitutions for materials, articles or process required under contract unless written approval is obtained. See the Division 1 for project substitution requirements.

1.10 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate the following installed conditions:
   1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
   2. Record drawings shall incorporate all accepted change orders and RFIs; reference number on drawings is not acceptable.
   3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
   4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
   5. Contract Modifications, actual equipment and materials installed.
   6. Record the locations and invert elevations of underground installations.

1.11 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and the following requirements. Division 22 manuals shall be hard cover, 3-post binder, and indexed by systems. Pages shall be same size, with exception of allowable foldout pages for control and flow diagrams. Cover shall be inscribed with name of project, Owner, description of contents, Architect, General Contractor, Mechanical Contractor, and date. In addition to the requirements specified in Division 1, include the following information in Division 22 materials:

   1. Product Data of all Division 22 equipment provided by the project as indicated in submittal requirements.
   2. Manufacturer's Equipment Installation and Start-Up Manuals for all equipment provided by the project. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
   3. Manufacturer's Equipment Service Manuals for all equipment provided by the project, including parts list, troubleshooting list and maintenance procedures for routine preventative maintenance. Include disassembly, repair, and reassembly; aligning and adjusting instructions; servicing instructions and lubrication charts and schedules
   4. Reports and Certificates of all Division 22 systems and equipment as required by specifications.
   5. Material Safety Data Sheets (MSDS) for all applicable materials used for Division 22 installations.
   6. Warranty Certificates for all equipment where extended warranties are either offered or required; provide supplier contact information.

1.12 QUALITY ASSURANCE

A. Equipment Selection: Equipment allowed by the specifications but with different electrical characteristics, physical dimensions, capacities, and/or ratings than what is shown on the

drawings may be furnished, provided such proposed equipment is approved in writing and connecting mechanical and electrical services, such as pipe and/or duct connection sizes, circuit breakers, conduit, motors, bases, and equipment spaces are revised to accommodate such equipment. All expenses shall be borne by the Contractor. Specified minimum energy ratings and/or equipment efficiencies must meet design and commissioning requirements.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored mechanical equipment, ducts, pipes and tubes and other materials from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Pipes, mechanical equipment, and other materials that are damaged due to improper storage shall be replaced at the Contractor's expense.

1.14 SEQUENCING AND SCHEDULING

A. Coordinate plumbing equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Some equipment may require temporary installation during one phase and require relocation to final location under another phase. Provide all associated labor and materials to accommodate this phasing.

F. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors if plumbing items requiring access are concealed behind finished surfaces.

PART 2 - EXECUTION

2.1 GENERAL PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment. Comply with the following requirements:

1. Coordinate plumbing systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for plumbing installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panel or doors where units are concealed behind finished surfaces. Notify General Contractor on the number, location and size of access panels or doors.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

2.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 22 piping Sections specify unique piping installation requirements.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design

considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. Install piping at indicated slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install flexible connectors according to manufacturer's written instructions where indicated and specified in other Division 22 sections.

L. Install flexible expansion loops according to manufacturer's written instructions where indicated and specified in other Division 22 sections.

M. Install fittings for changes in direction and branch connections.

N. Install couplings according to manufacturer's written instructions.

O. Do not route piping through elevator equipment rooms, unless specifically allowed by local authority.

P. Do not route piping over electrical panels, transformers, switchgear or other electrical equipment.

Q. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

R. Sleeves are not required for core drilled holes.

S. Permanent sleeves are not required for holes formed by PE removable sleeves.

T. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Build sleeves into new walls and slabs as work progresses.
3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

U. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

V. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for manufacturer’s recommended clear space between pipe and sleeve.

1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
2. Caulk exterior side of annular space once the mechanical sleeve seal is in place using an elastomeric joint sealant.

W. Verify final equipment locations for roughing-in.

X. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

Y. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

    a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
    b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
    c. Align threads at point of assembly.
    d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
    e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench to recommended torque valves.

Z. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

2.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to approved submittal data.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment giving right of way to piping installed at required slope.

2.4 PAINTING AND FINISHING

A. Refer to Architectural Divisions for paint materials, surface preparation, and application of paint.

B. Do not paint piping specialties with factory-applied finish.

C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

2.5 CONCRETE HOUSEKEEPING PADS

A. Construct concrete housekeeping pads of dimensions indicated, but not less than 4 inches larger in both directions for all floor-supported units. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations.

2.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

2.7 GROUTING

A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete housekeeping pads to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

2.8 EARTHWORK

A. General: Perform earthwork required for installation of mechanical work below grade in accordance with other Divisions.

B. Excavate trenches to uniform widths to provide a working clearance on each side of the pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated. Grade trench bottoms to provide uniform bearing and support for each section of pipe. Form holes and depressions for joints after trench bottom has been graded. Provide temporary pumping equipment to keep excavation free from water. Install pipe bedding in rock excavation consisting of not less than 6 inch of sand or equivalent material.

C. Provide bracing and shoring as necessary.

END OF SECTION 22 05 00

SECTION 22 07 13 - PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes preformed, rigid, and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

A. General: See Section 22 05 00 general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Product Data: Provide submittals of the following:

1. Mineral Fiber Insulation.
2. Flexible Elastomeric Thermal Insulation.
3. Cellular Glass Insulation.
4. Calcium Silicate Insulation.
5. Prefabricated Thermal Insulating Fitting Covers.
6. PVC Jacket.
7. Standard PVC Fitting Covers.
8. Aluminum Jacket.
9. Stainless Steel Jacket.
10. Thermal Insulated Removable Pads.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation and jackets from moisture and dirt.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for insulation application.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Knauf Fiberglass.
b. Owens Corning.
c. Johns Manville.

2. Preformed Pipe Insulation: Molded pipe insulation manufactured to meet ASTM C 585 for sizes required in the particular system. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547.

a. Factory applied paper free all service vapor retarding outer jacket and adhesive closure system rated for a maximum service temperature of 850 deg F. Circumferential joints shall be sealed with paper free butt strips that are compatible with facing.
b. Polybrominated Diphenyl Esters (PBDE's) are not allowed.
c. Alternate paper free insulation systems may include but are not limited to unfaced fiber glass pipe insulation with a field applied paper free jacket material such as Polyvinyl Chloride (PVC) or Polyvinylidene Chloride (PVDC).

3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. Water Based Fire-Resistive Adhesive: Comply with ASTM C 916 Type II in the following classes and grades:

a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

c. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Childers.
2) Foster.
3) Miracle.

5. Vapor Barrier Coating: Fire- and water-resistive, vapor barrier coatings for indoor applications. Comply with MIL-C-19565C, Type II and be QPL listed. Water Vapor Permeance. ASTM E 96 Procedure B, 0.013 perms or less at 43 mils dry.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Childers.
2) Foster.
3) Vimasco.

6. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
7. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
8. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armacell.

2. Adhesive: Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster.
b. Childers.
c. Armacell
d. K-Flex.

3. Ultraviolet-Protective Coating: Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster.
b. Armacell.

4. Metal Jacketing Flashing Sealant: Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster.
b. Childers.

C. Cellular Glass Insulation: All glass, closed cell structure, comply with ASTM C 552, operating temperature from minus 450 deg F to 900 deg F (-268 deg C to 482 deg C), thermal diffusivity

0.016 ft^2/Hr, no increase in weight at 90% relative humidity (hygroscopicity). Fabricate in half sections where possible, curved sidewall segments for larger diameter pipes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pittsburgh Corning (Foamglass), or approved equivalent.

2. Weather Barrier Coating: Flexible, latex coating, comply with ASTM E 84 and E 96.
3. Asphalt Cutback coating: Asphalt coating formulated for cellular glass insulation.
4. Polyester Fabric: Open mesh, synthetic fabric.
5. Joint Sealant: Butyl sealant, comply with MIL-I-24244.
6. Protective Membranes:

    a. Heat-Sealed Membrane: 125-mil thick heat-sealed high polymer asphalt membrane with an integral glass scrim, integral 1 mil aluminum foil, and mylar film.
    b. Self-Sealing Membrane: 70-mil thick self-sealing high polymer asphalt membrane with an integral glass scrim and mylar film.

D. Calcium Silicate Insulation: Preformed pipe sections of noncombustible, inorganic, hydrous calcium silicate with a nonasbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Owens Corning.
    b. Pabco.
    c. Johns Manville.

E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White.

C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers and end caps.
2. Adhesive: As recommended by insulation material manufacturer.
3. PVC Jacket Color: White.

D. Aluminum Jacket: ASTM B 209, 3003 alloy, H-14 temper, factory cut and rolled to indicated sizes or roll stock, ready for shop or field cutting and forming to indicated sizes.

1. Finish and Thickness: Stucco-embossed finish, 0.016 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

E. Stainless-Steel Jacket: ASTM A 666, Type 304 or 316; factory cut and rolled to indicated sizes or roll stock ready for shop or field cutting and forming to indicated sizes.

1. Finish and Thickness: Smooth finish, 0.10-inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.

2.3 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8-oz./sq. yd.

1. Tape Width: 4 inches.

B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.010 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

2.4 THERMAL INSULATED REMOVABLE PADS

A. The inner and outer jacketing on the removable pads shall be silicone impregnated fiberglass.

B. The insulation material inside the pads shall be fiberglass thermal insulating wool.

C. Lacing hooks, and washers shall be stainless steel.

D. Tie wire shall be stainless steel.

E. Fasteners shall be stainless steel staples STCR 5019-3/8-inch, or equal.

F. Thickness for all pads: 2-inch.

2.5 VAPOR RETARDERS

A. Vapor-Barrier Coating: Fire- and water-resistive, vapor-barrier coatings for indoor applications. Comply with MIL-C-19565C, Type II and be QPL listed. Water Vapor Permeance: ASTM E 96 Procedure B, 0.013 perms or less at 43 mils dry.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers.
b. Foster.
c. Vimasco.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder coating on below ambient insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply elastomeric insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier coating.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and coatings at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Barrier Coatings: Where vapor retarders are indicated, apply specified coating on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

All below ambient, insulated fittings, flanges, valves and unions shall be coated with vapor barrier coating and reinforcing mesh.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder coating.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-barrier coating.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal metal jacket to roof flashing with metal jacketing flashing sealant.

Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-barrier coating.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 07.

T. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-barrier coating where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-barrier coating. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-barrier coating.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Cover flanges with standard PVC fitting covers.

C. Apply insulation to fittings and elbows as follows:

1. Apply preformed insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings and elbows with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Cover valves and specialties with standard PVC fitting covers. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-barrier coating.
5. Provide thermal insulated removable pads for larger sizes where PVC fitting covers are not available.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with specified contact adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with contact adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with contact adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 CELLULAR GLASS INSULATION APPLICATION

A. Follow manufacturer’s written instructions for applying insulation.

B. Apply insulation to pipes, fittings, and elbows as follows:

1. Where vapor retarders are indicated, seal all joints full depth with joint sealant, fill tightly with no voids.
2. Provide protective membranes as indicated. Apply membranes at factory where possible.

3.7 CALCIUM SILICATE INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of insulation to pipe with stainless-steel bands at 12-inch intervals and tighten without deforming insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same material and thickness as pipe insulation.

4. Finish flange insulation the same as pipe insulation.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded sections of insulation are not available, apply mitered sections of calcium silicate insulation. Secure insulation materials with stainless-steel wire.
3. Finish insulation of fittings the same as pipe insulation.

D. Apply insulation to valves and specialties as follows:

1. Apply mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation the same as pipe insulation.

3.8 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

B. PVC Jackets:

1. Apply 1-inch overlap at longitudinal seams and end joints.
2. Seal with manufacturers recommended adhesive.
3. Apply PVC jackets for exposed piping in mechanical rooms [**up to 8-feet from floor**] and insulated piping within custom air-handling units.

C. Metal Jackets:

1. Apply 2-inch overlap at longitudinal seams and end joints.

   a. Overlap longitudinal seams arranged to shed water.
   b. Seal joints with metal jacketing recommended by jacket manufacturer.

2. Secure jacket with bands 12 inches o.c. and at end joints.
3. Apply stainless steel jackets for exposed piping in food service areas.
4. Apply aluminum jackets for exposed exterior installations.

3.9 FINISHES

A. Exterior Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.10 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Flow regulators.
8. Meters.
9. Backflow preventers.
10. Steam traps.
11. Pipe insulation is not required between the control valve and coil on runouts when the control valve is located within 4-feet of the coil and the pipe size is 1-inch or less.

3.11 THERMAL INSULATION REMOVABLE PADS

A. All flanges and valves including control valves, gate valves and butterfly valves shall be insulated with removable pads for systems that are indicated under the applications schedule.

3.12 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, thickness and vapor retarders.

3.13 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic hot and recirculated hot water.

1. Insulation Material: Mineral-fiber, preformed.
2. Insulation Thickness: Apply the following insulation thicknesses:

a. Pipe, 1/2-inch – 1-1/4-inch: 1-inch.
b. Pipe, 1-1/2-inch and above: 1-1/2-inch.

3. Vapor Retarder Required: No.
4. Insulation Conductivity Range: 0.21 – 0.28 BTU·in/(hr·ft^2·°F).

END OF SECTION 22 07 13

SECTION 22 11 00 – FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water distribution piping from locations indicated to fixtures and equipment inside building.

1.3 DEFINITIONS

A. Domestic Water Piping: Water piping that conveys potable cold and hot water to fixtures and equipment throughout the building.

B. Non-Potable Water Piping: Water piping inside building that conveys non-potable water to fixtures and equipment throughout the building.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Domestic Water Piping: 130 psig.

1.5 SUBMITTALS

A. General: See Section 22 05 00 “Common Work Results For Plumbing” for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Product Data: Provide submittals for the following:

1. Domestic water piping material.
2. Domestic water fittings.
3. Domestic water valves, and other specialties for a complete installation.

C. Reports and Certificates: Provide submittals of the following:

1. Test Reports specified in "Field Quality Control.”

D. Shop Drawings: As described in Section 22 05 00 “Common Work Results For Plumbing”.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

PART 2 - PRODUCTS

2.1 PIPE AND TUBE MATERIALS

A. General: All pipes inside the buildings for domestic hot and cold water supply shall be CPVC conforming to CTs SDR-13.5 at a working pressure of 320 PSI at 23 deg.C. and 80 PSI at 82 deg. C. Approved equal may be used if submitted by Contractor and Approved by Engineer

2.2 PIPE AND TUBE FITTINGS

A. General: Solvent welded CPVC fittings etc. tees, elbows, couplers, unions, reducers, brushing etc. including transition fittings (connection between CPVC and metal pipes/G.I. ie. brass adopters conforming to ASTM D-2846) shall be provided.

2.3 JOINING MATERIALS

A. General: Only CPVC solvent cement conforming to ASTMF 493 should be used for joining pipe with fittings and valves.

B. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined. When making a transition connection to metal threads, special brass/plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque. Teflon tape shall be used to make threaded connections leak proof.

2.4 VALVES

A. General: Valves shall be of same material & type as piping, and shall meet applicable codes.

PART 3 - EXECUTION

3.1 EXCAVATION

A. All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:

1. 15mm to 50mm: 30cms width, 75 cms depth

2. 65mm to 150mm: 45cms width, 100 cms depth

B. Before being laid in the trench each pipe and fitting shall be inspected and any dirt or foreign matter inside the pipe or fitting shall be removed. Spigots and sockets shall also be examined for cleanliness to ensure proper joints.

C. Trenches shall be refilled with suitable excavated material but not before the work has been measured and approved by the Engineer. For pipes which are not surrounded with concrete, the first layer of filling material shall be free from stones and shall not be thrown directly on to the pipes, but shall be placed and packed with care under and round them. All filling shall be deposited and compacted in layers, not exceeding 225 mm loose depth, to a dry density not less than that of the adjoining soil.

D. Adequate thrust blocking shall be provided for all underground water piping.

3.2 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, ball, or butterfly valves. Grooved-end butterfly valves may be used with grooved-end piping.
2. Balancing: Use circuit balancing valve.

3.4 PIPING INSTALLATION, GENERAL

A. Refer to Division 22 Section "Common Work Results For Plumbing" for basic piping installation.

3.5 SERVICE ENTRANCE PIPING INSTALLATION

A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building.

B. Install shutoff valve, hose-end drain valve, strainer, and pressure gage inside building at first accessible point for each service entrance pipe.

C. Install water-pressure regulators and backflow preventers downstream from shutoff valves. Refer to Division 22 Section "Water Distribution Piping Specialties" for water-pressure regulators and backflow preventers.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through exterior wall. Select number of interlocking rubber links required to make installation watertight.

3.6 DOMESTIC WATER PIPING INSTALLATION

A. Install piping with 0.25 percent slope downward toward drain.

3.7 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results For Plumbing" for basic piping joint construction.

3.8 VALVE INSTALLATION

A. Sectional Valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated.

B. Shutoff Valves: Install shutoff valves on each water supply to equipment, close to main, on each plumbing fixture without supply stops, and where indicated.

C. Drain Valves: Install hose end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.

D. Circuit Balancing Valves: Install in each hot-water circulation return branch as indicated in plan and diagrams, discharge side of each pump and circulator, and where indicated.

3.9 HANGER AND SUPPORT INSTALLATION

A. For horizontal runs, support should be given at 3 feet (90 cms) intervals for diameters of one inch and below and at 4 feet (1.2 m) intervals for larger sizes.

B. Supports should be as per the below mentioned table:

Size of pipe	20ºC	49ºC	71ºC	82ºC
Inch	Ft.	Ft.	Ft.	Ft.
½”	5.5	4.5	3.0	2.5
¾”	5.5	5.0	3.0	2.5
1”	6.0	5.5	3.5	3.0
1¼”	6.5	6.0	3.5	3.5
1¼”	7.0	6.0	3.5	3.5
2”	7.0	6.5	4.0	3.5

C. All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanized expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the Owner for any damage that may be caused by such failures.

3.10 CONNECTIONS

A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:

1. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.11 FIELD QUALITY CONTROL

A. Inspect water distribution piping as follows:

B. Inspect service entrance piping and water distribution piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Test service entrance piping and water distribution piping as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
3. Upon the completion of the work, the Contractor and the owner shall conduct pressure tests jointly. The hydrostatic testing procedure is subject to the approval of the Owner.
4. Water supply piping being tested should be capable of withstanding a testing pressure of 150 psi. Pressure shall be maintained for a period of at least thirty minutes without any drop.
5. All bends, fittings and valves shall be properly anchored before the test starts. Ends of the tested section must be securely closed and temporarily anchored as well. Sufficient backfilling where required as to prevent movement of all pipes during the tests, but with joint left exposed until testing has been completed.

6. A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.
7. Following testing, the domestic water systems shall be filled with a water-chlorine solution containing not less than (50) parts per million of chlorine which shall be held in the system for not less than twenty four hours. The system shall then be flushed until residual chlorine level is not greater than the flushing water.
8. Prepare and submit reports for tests and required corrective action.

3.12 CLEANING

A. Clean and disinfect potable-water distribution piping as follows:

1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.

    c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.

B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.13 START-UP PROCEDURES

A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

B. Perform the following steps before putting into operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.

E. Energize pumps and verify proper operation.

END OF SECTION 22 11 16

SECTION 23 11 13 - FACILITY FUEL-OIL PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fuel-oil pipes, tubes, and fittings.
2. Double-containment piping and fittings.
3. Piping specialties.
4. Joining materials.
5. Specialty valves.
6. Mechanical leak-detection valves.
7. Leak detection and monitoring system.
8. Labels and identification.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and dimensions of individual components and profiles.
2. Include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. For valves, include pressure rating, capacity, settings, and electrical connection data of selected models.

B. Shop Drawings: For fuel-oil piping, as described in Section 22 05 00 “Common Work Results For Plumbing”

1. Plans and details, drawn to scale, on which fuel-oil piping is shown and coordinated with other installations, using input from installers of the items involved.
2. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities. For fuel tank, indicate dimensions, vent sizes and location of all accessories including pumps, fill pipe, manways, tank supports, inventory sensor, and leak sensors. Provide a piping and instrument diagram for the system including a complete bill of material/equipment list.
3. Contractor shall provide design assist and conformance to all codes.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Pipe Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code.

C. A single vendor shall be responsible for furnishing the system equipment, piping, controls and all installation, programming, commissioning and owner training. The company shall be a licensed firm with 5 years of documented experience in the design and construction of emergency power fuel systems. The company shall provide evidence of professional liability and pollution liability insurance.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

D. Store PE pipes and valves protected from direct sunlight.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.

1. Failures due to defective materials or workmanship for materials including piping, dispenser sumps, water-tight sump entry boots, terminations, and other end fittings.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

C. Fuel-Oil Valves: Comply with UL 842 and have service mark initials "WOG" permanently marked on valve body.

D. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil piping.

2.2 PERFORMANCE REQUIREMENTS

A. Maximum Operating-Pressure Ratings: 3-psig (21-kPa) fuel-oil supply pressure at oil-fired appliances.

2.3 FUEL-OIL PIPES, TUBES, AND FITTINGS

A. See "Outdoor Piping Installation" and "Indoor Piping Installation" articles for where pipes, tubes, fittings, and joining materials are applied in various services.

B. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.
b. End Connections: Threaded or butt welding to match pipe.
c. Lapped Face: Not permitted underground.

d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.4 DOUBLE-CONTAINMENT PIPE AND FITTINGS

A. Flexible, Nonmetallic, Double-Containment Piping: Comply with UL 971.
1. Pipe Materials: PVDF complying with ASTM D 3222 for carrier pipe with mechanical couplings to seal carrier, and PE pipe complying with ASTM D 4976 for containment piping.
2. Watertight sump entry boots, pipe adapters with test ports and tubes, coaxial fittings, and couplings.
3. Minimum Operating Pressure Rating: 10 psig (69 kPa).
4. Plastic to Steel Pipe Transition Fittings: Factory-fabricated fittings with plastic end matching or compatible with carrier piping, and steel pipe end complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
5. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

B. Flexible, Metallic, Double-Containment Piping: Comply with UL 971A.
1. Pipe Materials:

a. Metallic Lining: ASTM A 240/ASTM A 240M Type 316 corrugated stainless steel tubing.
b. Carrier Pipe: Fluoropolymer tube.
c. Jacket: UV stabilized.

2. Watertight sump entry boots, pipe adapters with test ports and tubes, coaxial fittings, and couplings.
3. Minimum Operating Pressure Rating: 10 psig (69 kPa).
4. Plastic to Steel Pipe Transition Fittings: Factory-fabricated fittings with plastic end matching or compatible with carrier piping, and steel pipe end complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
5. Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

C. Rigid, Double-Containment Piping: Comply with UL 971.
1. RTRP: ASTM D 2996 or ASTM D 2997 carrier and containment piping and mechanical couplings to seal carrier and containment piping or individually bonded joints.

a. Minimum Operating-Pressure Rating for RTRP NPS 2 and NPS 3 (DN 50 and DN 80): 150 psig (1035 kPa).

b. Minimum Operating-Pressure Rating for RTRP NPS 4 and NPS 6 (DN 100 and DN 150): 125 psig (860 kPa). Compliance with UL 971 is not required for NPS 6 (DN 150) and larger piping.
c. Fittings: RTRF complying with ASTM D 2996 or ASTM D 2997 and made by RTRP manufacturer; watertight sump entry boots, termination, or other end fittings.

2. Leak-Detection System: Include design and fabrication of double-containment pipe and fitting assemblies with provision for field installation of cable leak-detection system in annular space between carrier and containment piping.

2.5 PIPING SPECIALTIES

A. Metallic Flexible Connectors:
1. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
2. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
3. Minimum Operating Pressure: 150 psig (1035 kPa).
4. End Connections: Socket, flanged, or threaded end to match connected piping.
5. Maximum Length: 30 inches (762 mm.)
6. Swivel end, 50-psig (345-kPa) maximum operating pressure.
7. Factory-furnished anode for connection to cathodic protection.

B. Nonmetallic Flexible Connectors:
1. Listed and labeled for underground applications by an NRTL acceptable to authorities having jurisdiction.
2. PFTE bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
3. Minimum Operating Pressure: 150 psig (1035 kPa).
4. End Connections: Socket, flanged, or threaded end to match connected piping.
5. Maximum Length: 30 inches (762 mm.)
6. Swivel end, 50-psig (345-kPa) maximum operating pressure.
7. Factory-furnished anode.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: [**60**] [**80**]-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: [**60**] [**80**]-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: [**60**] [**80**]-mesh startup strainer and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

F. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

2.6 JOINING MATERIALS

A. Joint Compound and Tape for Threaded Joints: Suitable for fuel oil.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

D. Bonding Adhesive for RTRP and RTRF: As recommended by piping and fitting manufacturer.

2.7 SPECIALTY VALVES

A. Pressure Relief Valves:
1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
2. Body: Brass, bronze, or cast steel.
3. Springs: Stainless steel, interchangeable.
4. Seat and Seal: Nitrile rubber.
5. Orifice: Stainless steel, interchangeable.
6. Factory-Applied Finish: Baked enamel.
7. Maximum Inlet Pressure: 150 psig (1035 kPa)
8. Relief Pressure Setting: 60 psig (414 kPa)

B. Oil Safety Valves:
   1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   2. Body: Brass, bronze, or cast steel.
   3. Springs: Stainless steel.
   4. Seat and Diaphragm: Nitrile rubber.
   5. Orifice: Stainless steel, interchangeable.
   6. Factory-Applied Finish: Baked enamel.
   7. Manual override port.
   8. Maximum Inlet Pressure: 60 psig (414 kPa)
   9. Maximum Outlet Pressure: 3 psig (21 kPa)

C. Emergency Shutoff Valves:
   1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
   2. Double poppet valve.
   3. Body: ASTM A 126, cast iron.
   4. Disk: FPM.
   5. Poppet Spring: Stainless steel.
   6. Stem: Plated brass.
   7. O-Ring: FPM.
   8. Packing Nut: PTFE-coated brass.
   9. Fusible link to close valve at 165 deg F (74 deg C).
   10. Thermal relief to vent line pressure buildup due to fire.
   11. Air test port.
   12. Maximum Operating Pressure: 0.5 psig (3.45 kPa).

2.8 MECHANICAL LEAK-DETECTION VALVES

A. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

B. Body: ASTM A 126, cast iron.

C. O-Rings: Elastomeric compatible with fuel oil.

D. Piston and Stem Seals: PTFE.

E. Stem and Spring: Stainless steel.

F. Piston Cylinder: Burnished brass.

G. Indicated Leak Rate: Maximum 3 gph (3 mL/s) at 10 psig (69 kPa).

H. Leak Indication: Reduced flow.

2.9 LEAK-DETECTION AND MONITORING SYSTEM

A. Cable and Sensor System: Comply with UL 1238.

1. Calibrated leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil piping.
2. Include fittings and devices required for testing.

2.10 LABELS AND IDENTIFICATION

A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (152 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (762 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of fuel-oil piping.

B. Examine installation of fuel-burning equipment and fuel-handling and storage equipment to verify actual locations of piping connections before installing fuel-oil piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Comply with requirements in Earthwork Section excavating, trenching, and backfilling.

3.3 PREPARATION

A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.

B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.4 OUTDOOR PIPING INSTALLATION

A. Install Underground Fuel-Oil Piping Buried:

1. Under Compacted Backfill: 18 inches (457 mm) below finished grade.
2. Under Asphalt 2 Inches (51 mm) Thick: 8 inches (203 mm) below bottom of asphalt.
3. Under 4 Inches (102 mm) of Reinforced Concrete in Areas Subject to Vehicle Traffic: 4 inches (102 mm) below bottom of concrete.
4. If fuel-oil piping is installed with less than 12 inches (305 mm) of cover to finished grade, install in containment piping.
5. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

B. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining, to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer. Review protective coating damage with Architect prior to repair.
3. Replace pipe having damaged PE coating with new pipe.

C. Install double-containment, fuel-oil pipe at a minimum slope of 1 percent downward toward fuel-oil storage tank sump.

D. Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.

E. Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.

F. Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST and UST.

G. Install fittings for changes in direction in rigid pipe.

H. Install system components with pressure rating equal to or greater than system operating pressure.

3.5 INDOOR PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction to allow for mechanical installations.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings at a height that allows sufficient space for ceiling panel removal.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Comply with requirements for equipment specifications for roughing-in requirements.

I. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.

J. Prohibited Locations:

1. Do not install fuel-oil piping in or through HVAC ducts and plenums, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
2. Do not install fuel-oil piping in solid walls or partitions.

K. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

L. Connect branch piping from top or side of horizontal piping.

M. Install unions in pipes NPS 2 (DN 50) and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.

N. Do not use fuel-oil piping as grounding electrode.

O. Install sleeves and sleeve seals for piping penetrations of walls, ceilings, and floors.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.6 VALVE INSTALLATION

A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.

B. Install valves in accessible locations.

C. Install oil safety valves at inlet of each oil-fired appliance.

D. Install pressure relief valves in distribution piping between the supply and return lines.

E. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.

F. Install manual air vents at high points in fuel-oil piping.

G. Install emergency shutoff valves at dispensers.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Bevel plain ends of steel pipe.
2. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tubing" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

G. Flared Joints: Comply with SAE J513. Tighten finger tight then use wrench according to fitting manufacturer's written instructions. Do not overtighten.

H. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.8 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1-1/4 (DN 32) and Smaller: Maximum span, 84 inches (2130 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/2 (DN 40): Maximum span, 108 inches (2740 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
6. NPS 4 (DN 100): Maximum span, 13 feet (4 m); minimum rod size, 5/8 inch (16 mm).

C. Install hangers for horizontal, drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20) and Smaller: Maximum span, 60 inches (1524 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1 (DN 25): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/4 (DN 32): Maximum span, 84 inches (2130 mm); minimum rod size, 3/8 inch (10 mm).

4. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2740 mm); minimum rod size, 1/2 inch (13 mm).
6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
7. NPS 4 (DN 100): Maximum span, 11 feet (3.4 m); minimum rod size, 5/8 inch (16 mm).

D. Support vertical copper tube at each floor and at spacing not greater than 10 feet (3 m).

3.9 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.

B. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor cable probes in interstitial space of double-containment piping.

3.10 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance.

B. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

C. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

D. Connect piping to equipment with shutoff valve and union. Install union between valve and equipment.

E. Install flexible piping connectors at final connection to burners or oil-fired appliances.

3.11 LABELING AND IDENTIFYING

A. Nameplates, pipe identification, valve tags, and signs are specified in Section 230553 "Identification for HVAC Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.

1. Text: In addition to identifying unit, distinguish between multiple units; inform operator of operational requirements; indicate safety and emergency precautions; and warn of hazards and improper operations.

C. Install detectable warning tape directly above fuel-oil piping, 12 inches (304 mm) below finished grade, except 6 inches (152 mm) below subgrade under pavements and slabs. Terminate tracer wire in an accessible area, and identify as "tracer wire" for future use with plastic-laminate sign.

1. Piping: Over underground fuel-oil distribution piping.

3.12 FIELD QUALITY CONTROL

A. Pressure Test Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:

1. Fuel-Oil Distribution Piping: Minimum 5 psig (34.5 kPa) for minimum 30 minutes.
2. Fuel-Oil, Double-Containment Piping:

    a. Carrier Pipe: Minimum 5 psig (34.5 kPa) for minimum 30 minutes.
    b. Containment Conduit: Minimum 5 psig (34.5 kPa) for minimum 60 minutes.

3. Suction Piping: Minimum 20-in. Hg (68 kPa) for minimum 30 minutes.
4. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig (69 kPa).

B. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.

C. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Bleed air from fuel-oil piping using manual air vents.

F. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground Fuel-Oil Piping: Flexible, double-containment piping. Size indicated is carrier-pipe size.

B. Underground fuel-oil-tank fill and vent piping shall be one of the following:

1. NPS 2 (DN 50) and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints. Coat pipe and fittings with protective coating for steel piping.
2. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel welding fittings, and welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Aboveground fuel-oil piping shall be one of the following:

1. NPS 2 (DN 50) and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
2. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel welding fittings, and welded joints.
3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.

3.14 INDOOR PIPING SCHEDULE

A. Aboveground fuel-oil piping shall be one of the following:

1. NPS 1/2 (DN 15) and Smaller: Annealed-temper copper pipe, wrought copper fittings, and brazed or flared joints.
2. NPS 5/8 to NPS 2 (DN 18 to DN 50): Steel pipe, steel or malleable-iron threaded fittings, and threaded joints
3. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel fittings, and welded or flanged joints

3.15 SHUTOFF VALVE SCHEDULE

A. Valves for aboveground distribution piping NPS 2 (DN 50) and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

B. Distribution piping valves for pipe NPS 2-1/2 (DN 65) and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze, nonlubricated plug valve.

C. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231113

SECTION 23 12 13 - FACILITY FUEL-OIL PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submersible fuel-oil storage tank pumps.
2. Simplex fuel-oil pumps.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and dimensions of individual components and profiles.
2. Include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fuel-oil pumps.

1. Include construction details and dimensions of individual components for fuel-oil pumps.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities. For fuel tank, indicate dimensions, vent sizes and location of all accessories including pumps, fill pipe, manways, tank supports,

inventory sensor, and leak sensors. Provide a piping and instrument diagram for the system including a complete bill of material/equipment list.

4. Contractor shall provide design assist and conformance to all codes.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-oil pumps and fuel-oil maintenance systems to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. A single vendor shall be responsible for furnishing the system equipment, piping, controls and all installation, programming, commissioning and owner training. The company shall be a licensed firm with 5 years of documented experience in the design and construction of emergency power fuel systems. The company shall provide evidence of professional liability and pollution liability insurance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Maximum Operating-Pressure Ratings: 3-psig (21-kPa) fuel-oil supply pressure at oil-fired appliances.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

2.2 SUBMERSIBLE FUEL-OIL STORAGE TANK PUMPS

A. Description: Comply with UL 79, UL 87, and UL 343.

1. Impeller: Turbine.
2. Housing and Volute: Cast iron.
3. Bearings: Bronze, self-lubricating.
4. Seals: Mechanical.
5. Shaft: Polished steel.
6. Suspension Piping: Telescoping to accommodate tank diameter and depth of bury.
7. Base: Steel.
8. Pressure Relief: Built in.
9. Discharge Check Valve: Built in.
10. Drive: Direct, close coupled.

B. Controls: Pump controller panel complying with UL 353 and UL 508C and with interlock and terminals for connections to fuel-oil-burning equipment.

1. Maintain minimum manifold pressure with outdoor-air temperature less than 60 deg F (16 deg C)
2. Seven-day schedule.
3. Stage multiple pumps to maintain pressure at a common supply manifold.
4. Alternate pumps to equalize run time.
5. Alarm motor failure.
6. Manual reset dry-run protection.
7. Stop pumps if fuel level falls below pump suction.
8. De-energize and sound alarm for pump, locked-rotor condition.
9. Sound alarm for open circuit and for high and low voltage.
10. Lights shall indicate normal power on, run, and off conditions.
11. Interface with automatic control system. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" to control and indicate the following:

    a. Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.
    b. Operating status.
    c. Alarm off-normal status.

2.3 SIMPLEX FUEL-OIL TRANSFER PUMPS

A. Description: Comply with UL 343 and HI 3.1-3.5.

1. Type: Positive-displacement, rotary type.
2. Impeller: Steel gear with crescent.
3. Housing: Cast-iron foot mounted.
4. Bearings: Bronze, self-lubricating.
5. Shaft: Polished steel.
6. Seals: Mechanical.
7. Base: Steel.
8. Pressure Relief: Built in.
9. Discharge Check Valve: Built in.

B. Controls:

1. Maintain minimum manifold pressure with outdoor-air temperature less than 60 deg F (16 deg C)
2. Seven-day schedule.
3. Alarm motor failure.
4. Manual reset dry-run protection.
5. Stop pump if fuel level falls below pump suction.
6. De-energize and sound alarm for pump, locked-rotor condition.
7. Sound alarm for open circuit and for high and low voltage.
8. Lights shall indicate normal power on, run, and off conditions.
9. Interface with automatic control system. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" to control and indicate the following:

    a. Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.
    b. Operating status.

c. Alarm off-normal status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for fuel-oil pumps to verify actual locations of pump connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Comply with requirements in Earthwork Section for excavating, trenching, and backfilling.

3.3 PREPARATION

A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.

B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.4 FUEL-OIL PUMP INSTALLATION

A. Submersible Pumps:

1. Suspend pumps from supply piping and anchored to bottom of tank.

B. Transfer Pumps:

1. Install pumps with access space for periodic maintenance including removal of motors, impellers, and accessories.
2. Set pumps on and anchor to concrete base.
3. Pump Mounting:

    a. Install base-mounted pumps on cast-in-place concrete equipment bases.
    b. Comply with requirements for vibration isolation.
    c. Comply with requirements for vibration isolation devices.

4. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

C. Install two-piece, full-port ball valves at suction and discharge of pumps.

D. Install mechanical leak-detector valves at pump discharge.

E. Install strainer on inlet side of simplex fuel-oil pumps.

F. Install check valve on discharge of simplex fuel-oil pumps.

G. Install suction piping with minimum fittings and change of direction.

H. Install vacuum and pressure gage, upstream and downstream, respectively, at each pump to measure the differential pressure across the pump.

3.5 FUEL MAINTENANCE SYSTEM INSTALLATION

A. Install suction line, with foot valve, at one end of storage tank, 1 inch (25 mm) from the bottom of tank.

B. Install return line at the opposite end of storage tank from suction line.

3.6 LABELING AND IDENTIFYING

A. Install nameplates and signs on each fuel-oil pump.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Start fuel-oil transfer pumps to verify for proper operation of pump, and check for leaks.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Fuel-oil pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fuel-oil pumps.

END OF SECTION 231213

SECTION 22 13 00 – FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sanitary drainage and vent piping, and storm drainage piping inside building and to locations indicated.

1.3 SUBMITTALS

A. General: See Section 22 05 00 “Common Work Results For Plumbing” for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Product Data: Provide submittals for all materials and equipment contractor intends to use.

C. Reports and Certificates: Provide submittals of the following:

1. Test Reports specified in "Field Quality Control.”

D. Shop Drawings: As described in Section 22 05 00 “Common Work Results For Plumbing”.

1.4 DEFINITIONS

A. Soil, Waste, and Vent Piping: Piping inside building that conveys wastewater and vapors from fixtures and equipment throughout the building.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Systems: 10-foot head of water.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. All soil, waste, and vent pipes and fittings shall be uPVC. All pipes shall be straight and smooth as specified in Schedule of Quantities. Pipe shall be Schedule 40 or 80, Type I, Grade I (Class 12454-B), conforming to ASTM D 1784 and D 1785.

B. Fittings shall be uPVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe. Provide fittings that have the same schedule as the pipe.
   1. Where identified, fittings shall be Schedule 80 conforming to ASTM D 2464 for threaded type and ASTM D 2467 for socket type.

C. UPVC pipes shall be clamped to the wall with approved type uPVC saddle clamps/U clamps and rod fixed to the angle iron support system within the shaft.

D. Use proper uPVC pipe adapters for connections between cast iron pipes, traps, and uPVC pipes where necessary. Such joints shall be made of an approved type of putty

E. UPVC underground drain pipes and fittings shall be golden brown colour underground pipes and shall comply with ISO/DIS 4435 Unplasticized P.V.C. pipes and fittings for buried drains or with B.S. 4660 or B.S. 5481 complete with coupling rings and relevant sealing compound and laid and jointed strictly in accordance with the manufacturer's printed instructions

F. Transition Couplings for Underground Pressure Piping: AWWA C219 metal, sleeve-type coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 TRAPS

A. Sinks and Showers: Chrome plated brass bottle trap 32 mm dia, with 75 mm clear water seal. No bottle trap shall be installed below ground.

B. All others and those below ground: Chrome plated p-trap.

2.3 CLEAN OUT PLUGS

A. Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, “Y’s” and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass screwed to a socket. The socket shall be connected to the drain pipes.

2.4 FLOOR DRAINS & FLOOR SINKS

A. Each floor drain and floor sink shall be provided with a stainless steel cockroach trap, and stainless steel floor grating as specified on plans.

PART 3 - EXECUTION

3.1 EXCAVATION & TRENCHES

A. Before being laid in the trench each pipe and fitting shall be inspected and any dirt or foreign matter inside the pipe or fitting shall be removed. Spigots and sockets shall also be examined for cleanliness to ensure proper joints.

B. Trenches shall be refilled with suitable excavated material but not before the work has been measured and approved by the Engineer. For pipes which are not surrounded with concrete, the first layer of filling material shall be free from stones and shall not be thrown directly on to the pipes, but shall be placed and packed with care under and round them. All filling shall be deposited and compacted in layers, not exceeding 225 mm loose depth, to a dry density not less than that of the adjoining soil.

3.2 DRAINAGE AND VENT PIPING INSTALLATION

A. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

1. All horizontal soil and waste pipes shall be sloped at 2%
2. All horizontal vent piping shall have a minimal slope back towards the fixture.

B. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

C. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

D. Clamps, hangers and supports on RCC walls, columns & slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

E. All pipe clamps, supports, nuts, bolts, washers shall be galvanised MS steel throughout the building. Painted MS clamps & MS nuts, bolts & washers shall not be accepted.

F. The vent stack shall terminate above roof level and where stack passes through the roof, weather apron shall be provided. The open end of each stack shall be fitted with a plastic coated, or galvanized steel, wire guard.

3.3 JOINT CONSTRUCTION

A. Pipe and fitting joints shall be solvent welded except where threaded joints are required. Solvent cement for socket joints shall comply with ASTM D 2564 and F 656.

B. During progress of the works, all open ends of the drains to be temporarily sealed off with solid plugs.

C. Where shown on the drawings, existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drains or channels. All such connection shall be made during the construction of the main sewer, drain or other work and a record of their positions kept for further use or reference. Where pipe connections are made to a sewer, culvert, stone pitched or lined channel, the pipes shall be well and tightly built into the concrete, or masonry work and be so placed as to discharge in the direction of flow of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are be- tween pipe sewers or drains, special connection pipes as shown on the drawings shall be sup- plied and be truly laid and properly jointed.

3.4 HANGER AND SUPPORT INSTALLATION

A. For all interior runs, support should be given at 4 feet (120 cms) intervals for all diameters

B. All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanized expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the Owner for any damage that may be caused by such failures.

3.5 FIELD QUALITY CONTROL

A. Inspect soil, waste, and vent piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

    a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection (24 hours). Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug ventstack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare and submit reports for tests and required corrective action.

3.6 CLEANING AND PROTECTING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 13 00

SECTION 22 13 13 - FACILITY FUEL-OIL STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Composite, steel, fuel-oil USTs.
2. Jacketed, steel, fuel-oil USTs.
3. FRP fuel-oil USTs.
4. Liquid-level gage systems.
5. Leak-detection systems.
6. Fuel oil.

1.3 DEFINITIONS

A. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

B. FRP: Glass-fiber-reinforced plastic.

C. UST: Underground storage tank.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and dimensions of individual components and profiles.
2. Include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Leak-detection and monitoring system.

B. Shop Drawings: For underground fuel-oil storage tanks.

1. Include plans, elevations, sections, and ballast pads and anchors, and lifting or supporting points.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities. For fuel tank, indicate dimensions, vent sizes and location of all accessories including pumps, fill pipe, manways, tank supports, inventory sensor, and leak sensors. Provide a piping and instrument diagram for the system including a complete bill of material/equipment list.
4. Contractor shall provide design assist and conformance to all codes.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: FRP tanks; trained and certified by the tank manufacturer.

B. Underground Fuel-Oil Storage Tanks: Comply with requirements of the EPA and of state and local authorities having jurisdiction, including recording fuel-oil storage tanks.

C. A single vendor shall be responsible for furnishing the system equipment, piping, controls and all installation, programming, commissioning and owner training. The company shall be a licensed firm with 5 years of documented experience in the design and construction of emergency power fuel systems. The company shall provide evidence of professional liability and pollution liability insurance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-oil storage tanks that fail in materials or workmanship within specified warranty period.

1. Storage Tanks:

a. Failures include, but are not limited to, the following when used for storage of fuel oil at temperatures not exceeding 150 deg F (66 deg C):

1) Structural failures including cracking, breakup, and collapse.
2) Corrosion failure including external and internal corrosion of steel tanks.

b. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEEL, FUEL-OIL UST WITH STI-P3

A. Description: UL 58 and STI P3, double-wall, horizontal, steel tank; with cathodic protection and electrical isolation.

1. Containment Method: STI-P3, Type II, with interstitial space.

B. Construction: Fabricated with welded steel; suitable for operation at atmospheric pressure and for storing liquids with specific gravity up to 1.1; fabricated for the following loads:

1. Depth of Bury: 36 inches (900 mm) from top of tank to finished surface.
2. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
3. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

C. Corrosion-Protection System: Protect tank and factory-installed piping by engineered and installed corrosion-protection system according to STI P3, with means of monitoring cathodic protection.

2.2 COMPOSITE, STEEL, FUEL-OIL UST

A. Description: UL 58, double-wall, horizontal, composite tank; with coating complying with UL 1746 and STI F894.

1. Containment Method: STI F894, Type II, with interstitial space.

B. Construction: Fabricated with welded steel and factory coating according to UL 1746 and STI F894; suitable for operation at atmospheric pressure and for storing liquids with specific gravity up to 1.1; fabricated for the following loads:

1. Depth of Bury: 36 inches (900 mm) from top of tank to finished surface.
2. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
3. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

2.3 JACKETED, STEEL, FUEL-OIL UST

A. Description: Jacketed, horizontal, steel tank; complying with UL 58, and with plastic or fiberglass jacket and corrosion-protection system according to UL 1746 and STI F922.

B. Construction: Tank fabricated with welded carbon steel, and jacket fabricated with plastic or fiberglass and vacuum-sealed interstitial space; suitable for operation at atmospheric pressure and with integral leak-detection device. Tank fabricated for the following loads:

1. Depth of Bury: 36 inches (900 mm) from top of tank to finished surface.
2. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
3. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

2.4 FRP FUEL-OIL UST

A. Description: Horizontal, FRP UST; UL 1316, double wall, with interstitial space and integral, hydrostatic, leak-detection and monitoring system.

B. Construction: Fabricated with fiberglass-reinforced polyester resins; suitable for operation at atmospheric pressure; fabricated for the following loads:

1. Depth of Bury: 36 inches (900 mm) from top of tank to finished surface.
2. External Hydrostatic Pressure: To withstand general buckling with safety factor of 2:1 if hole is fully flooded.
3. Surface Loads: AASHTO's "Specifications for Highway Bridges," H-20 axle loads of 32,000 lb (14 515 kg).

2.5 FUEL-OIL UST ACCESSORIES

A. Tank Manholes: 22-inch- (560-mm-) minimum diameter; bolted, flanged, and gasketed, with extension collar; for access to inside of tank.

B. Steel Tank Masonry Supports: Two 6-by-6-by-3/8-inch (150-by-150-by-10-mm) steel angles, 72 inches (1800 mm) long, located longitudinally on tank on each side of manholes and continuously welded in place.

C. Threaded pipe connection fittings on top of tank for fill, supply, return, vent, sounding, and gaging; in locations and of sizes indicated. Include cast-iron plugs for shipping.

D. Striker Plates: Inside tank, on bottom below fill, vent, sounding, gage, and other tube openings.

E. Lifting Lugs: For handling and installation.

F. Ladders: Carbon-steel ladder inside tank, anchored to top and bottom. Include reinforcement of tank at bottom of ladder.

G. Supply Tube: Extension of supply piping fitting into tank, terminating 6 inches (150 mm) above tank bottom and cut at a 45-degree angle.

H. Sounding and Gage Tubes: Extension of fitting into tank, terminating 6 inches (150 mm) above tank bottom and cut at a 45-degree angle.

I. Containment Sumps: Fiberglass or PE with sump base, add-on extension pieces as required, sump top, lid, and gasket-seal joints. Include sump entry boots for pipe penetrations through sidewalls.

J. Sump Entry Boots: Two-part pipe fitting for field assembly and of size required to fit over pipe. Include gaskets shaped to fit sump sidewall, sleeves, seals, and clamps as required for liquid-tight pipe penetrations.

K. Anchor Straps: Storage tank manufacturer's standard anchoring system, with straps, strap-insulating material, cables, and turnbuckles; of strength at least one and one-half times maximum uplift force of empty tank without backfill in place.

L. Filter Mat: Geotextile woven or spun filter fabric, in 1 or more layers, for minimum total weight of 3 oz./sq. yd. (101.7 g/sq. m).

M. Overfill Prevention Valves: Factory fabricated or shop or field assembled from manufacturer's standard components. Include drop tube, cap, fill nozzle adaptor, check valve mechanism or other devices, and vent if required to restrict flow at 95 percent of tank capacity.

2.6 GENERATOR 'BELLY' DAY TANK

A. General: Provide a packaged design fuel day tank control system. Day tank shall be for use with main supply pump in order to provide an automatic, self-refilling fuel supply system. Where a duplex or remote pump set is used, the day tank shall be equipped with dual inlet solenoid valves, manual bypass valve, sensors, and PLC based network control panel.

B. Design Criteria
1. Day Tank Capacity: As indicated on the Drawings.
2. Return Pump: Minimum ___ GPH.
3. Day Tank Construction
   a. All welded steel atmospheric tank of rectangular construction built in accordance with Codes and Standards noted above for indoor use with fuel oil.
   b. Pipe thread connections shall be provided for fuel oil supply from main tank, supply to prime mover, return from prime mover, overflow to main tank, vent and drain with ball valve. The drain will penetrate the containment described below. A weatherproof screened vent cap shall be provided as a loose item for field installation at the door vent termination.
   c. An inspection port in the top shall be provided.
   d. The tank shall be equipped with a welded steel channel base suitable for bolt attachment to a concrete pad.
   e. The tank shall be UL 142 listed.
   f. The exterior of the day tank and the interior and exterior of the containment described below shall receive a heavy duty industrial anti-corrosion coating and be finish painted.
   g. All day tank system components shall be protected by a removable steel equipment cover, if installed outdoors.
   h. Day tank shall be factory leak tested at 5 psi.
   i. The tank shall be installed and anchored within a steel containment basin having a minimum capacity of 110% that of the day tank. The containment shall be protected against intrusion of debris, falling water. The containment shall be equipped with a leak detector that shall activate the "rupture" alarm described below. Provide a drain with ball valve.

2.7 LIQUID-LEVEL GAGE SYSTEM

A. Description: Calibrated, liquid-level gage system complying with UL 180 with floats or UL 1238 with probes or other sensors and remote annunciator panel.

B. Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.

C. Controls: Electrical, operating on 120 V ac.

2.8 LEAK-DETECTION AND MONITORING SYSTEM

A. Cable and Sensor System: Comply with UL 1238.

1. Calibrated, leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil storage tanks and fuel-oil piping.
2. Include fittings and devices required for testing.
3. Controls: Electrical, operating on 120-V ac.
4. Calibrated, liquid-level gage complying with UL 180 with floats or UL 1238 with probes or other sensors and remote annunciator panel.
5. Remote Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.
6. Controls: Electrical, operating on 120-V ac.

2.9 FUEL OIL

A. Fuel Oil: ASTM D 396

B. Diesel Fuel Oil: ASTM D 975, high volatility.

2.10 CONCRETE MANHOLES

A. Precast Concrete Manhole Sections: ASTM C 478 (ASTM C 478M), base and concentric-cone sections with integral ladder or steps.

B. Cast-Iron Frame and Cover: Heavy-duty, water-resistant, cast-iron manhole frame, gasket, and bolted cover; 24-inch- (609-mm) diameter, inside opening dimension; 8-inch (203-mm) frame riser height.

2.11 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (152 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (762 mm) deep; colored yellow.

2.12 SOURCE QUALITY CONTROL

A. Pressure test and inspect fuel-oil storage tanks, after fabrication and before shipment, according to ASME and the following:

1. Horizontal, Steel USTs with the STI-P3 Corrosion-Protection System: UL 58 and STI P3.
2. Composite, Composite and Jacketed, Jacketed, Steel USTs: UL 58.

3. FRP USTs: UL 1316.

B. Affix standards organization's code stamp.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for underground fuel-oil storage tanks to verify actual locations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

B. Excavate to sufficient depth for a minimum of 36 inches (900 mm) of earth cover from top of tank to finished grade. Allow for cast-in-place, concrete-ballast base plus 6 inches (150 mm) of sand or pea gravel between ballast base and tank. Extend excavation at least 12 inches (300 mm) around perimeter of tank.

C. Backfill excavation with clean sand or pea gravel in 12-inch (305-mm) lifts and tamp backfill lift to consolidate.

D. Install filter mat between top of backfill material and earth fill.

3.3 FUEL-OIL UST INSTALLATION

A. Set tie-down eyelets for hold-down straps in concrete-ballast base and tie to reinforcing steel.

B. Place 6 inches (152 mm) of clean sand or pea gravel on top of concrete-ballast base.

C. Set tank on fill materials and install hold-down straps.

D. Connect piping.

E. Install tank leak-detection and monitoring devices.

F. Install containment sumps.

G. Install steel USTs with the STI-P3 corrosion-protection system according to STI R821 and STI R891. Protect anodes during tank placement and backfilling operations.

H. Install composite, steel USTs according to STI R913 and STI R891.

I. Install jacketed, steel USTs according to STI R923 and STI R891.

J. Install FRP USTs with FRP hold-down straps, manhole extensions, and manhole risers.

K. Fill storage tanks with fuel oil.

3.4 LIQUID-LEVEL GAGE SYSTEM INSTALLATION

A. Install liquid-level gage system. Install panel inside building where indicated.

3.5 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.

1. Double-Wall, Fuel-Oil Storage Tanks: Install probes or Install probes or use factory-installed integral probes, or Use factory-installed integral probes in interstitial space.
2. Single-Wall, Fuel-Oil Storage Tanks: Install probes as indicated.
3. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor probes in fuel-oil storage tank containment sumps and at low points in piping or cable probes in interstitial space of double-containment piping.
4. Install liquid-level gage.

3.6 LABELING AND IDENTIFYING

A. Nameplates, pipe identification, and signs are specified in Section 230553 "Identification for HVAC Piping and Equipment."

B. Install detectable warning tape directly above UST, 12 inches (304 mm) below finished grade, except 6 inches (152 mm) below subgrade under pavements and slabs.

1. Terminate tracer wire in an accessible area, and identify as "tracer wire" for future use with plastic-laminate sign.
2. Install over edges of each UST.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Tanks: Minimum hydrostatic or compressed-air test pressures for fuel-oil storage tanks that have not been factory tested and do not bear the ASME code stamp or a listing mark acceptable to authorities having jurisdiction:

a. Double-Wall Tanks:

1) Inner Tanks: Minimum 3 psig (20.7 kPa) and maximum 5 psig (34.5 kPa).
2) Interstitial Space: Minimum 3 psig (20.7 kPa) and maximum 5 psig (34.5 kPa), or 5.3-in. Hg (18-kPa) vacuum.

b. Where vertical height of fill and vent pipes is such that the static head imposed on the bottom of the tank is greater than 10 psig (69 kPa), hydrostatically test the tank and fill and vent pipes to a pressure equal to the static head thus imposed.
c. Maintain the test pressure for one hour.

B. USTs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 231313

SECTION 22 33 00 – PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes all plumbing equipment.

1.3 SUBMITTALS

A. General: See Section 22 05 00 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Product Data: Provide submittals of the following:

1. Commercial water heaters.
2. Solar domestic water heater.
3. Expansion tanks.
4. Accessories.

C. Maintenance Data: For water heaters and heat exchangers to include in maintenance manuals specified in Division 01.

D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters and heat exchangers through one source from a single manufacturer.

B. ASME Compliance: Fabricate and label heat exchangers, water heaters, and hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1 and Section IV, “Rules for Construction of Heating Boilers,” Part HLW Requirements for Potable-Water Heaters.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addi-

tion to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 BASIC, COMMON FEATURES

A. Products to be as specified on drawings. Any contractor proposed substitution. at minimum. to be equivalent in material and performance of engineer specified product. Products listed as "Basis of Design: plumbing equipment schedules.

2.2 HOT WATER STORAGE TANK

A. Connected with piping to circulator and water heater.

1. Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with125-psig working-pressure rating.

    a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
    b. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
    c. Jacket: Steel, with enameled finish.

2. Anode Rods: Factory installed, magnesium.
3. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

B. Mounting: Water heater, tank, and accessories factory mounted on skids.

2.3 COMMERCIAL, STORAGE, OVER 40 GALLONS, ELECTRIC WATER HEATERS

A. Manufacturers: Subject to compliance with requirements.

B. Description: Comply with UL 1453.

C. Storage Tank Construction: Steel with 150-psig working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.

    a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
    b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Handhole Cleanout: Provide one or more cleanouts.
5. Jacket: Steel, with enameled finish.

D. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of three.

1. Exception: Water heaters up to 9-kW input may have 2 or 3 elements.
2. Staging: Input not exceeding 18 kW per step.
3. Temperature Control: Adjustable[**, immersion**][**, surface-mounted**] thermostat.
4. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

E. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

F. Anode Rods: Factory installed, magnesium.

G. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.

H. T&P Relief Valve: Factory installed, ASME rated.

2.4 SOLAR COLLECTORS

A. Manufacturers: Subject to compliance with requirements. Basis of design manufacturers listed on equipment schedules.

B. Description: ASHRAE 93 certified: liquid flat-plate collectors, and concentrated solar collectors. Provide factory fabricated and assembled collector panels. Internal manifold collectors may be used if manufacturer standard. Include the following design features:
1. Collector Sizes: Maximum filled weight not to exceed 24.40 kg per square meter [five pounds per square foot] of gross collector area.
2. Minimum Performance Parameters: Provide total collector flow rate in accordance with manufacturer's recommendations. Provide instantaneous collector efficiency as follows:

Minimum Instantaneous Collector Efficiency, Percent	Inlet Fluid Parameter
74	0.00
54	0.03
40	0.05

Determine inlet fluid parameter (IFP) in accordance with the following formula:

IFP = (A – B)/C

Where:

a. A = Liquid inlet temperature in collector

b. B = Ambient air temperature
c. C = Solar flux

3. Absorber: Fabricate of 1" type M ASTM B 88 with NSF 61 certification copper tubes with copper fins.
4. Absorber Plate Coating: Electroplated selective crystal clear coating. Provide coating with minimum absorptivity 0.93, and maximum emissivity 0.14.
5. Collector Frame: Fabricate from 6063-T6 aluminum frame and battens per ANSI H35.1 with an architectural grade medium bronze polyester finish. Provide insulation with foil faced, glass fiber reinforced, polyisocyanurate rigid foam board manufactured using free rise process, 1.25" R8.0 in back and ¾" R5.0 in sidewalls and insulation complies with ASTM C1289, type I, Class 2 codes. Provide UV durable EPDM, continuous U-channel hasket with over-molded corners to prohibit water penetration and assure longer life, and grommets made from extruded silicone.
6. Collector Cover (Glazing Material): ASTM C1948 and ANSI Z97.1 with a CPSC 16 CFR 1201 Category II break pattern glass with total solar transmission (NREL 290-2600 nm) of 89% and maximum transmission of 91.57% at 565nm.
7. Collector Identification: On each collector, provide the following information:

a. Manufacturer's name or trademark
b. Model name or number
c. Certifying agency label and rating.

8. Other Components: Provide collectors for the complete removal of internal moisture which may develop in the collectors.
9. Collector Supports: Provide a commercial integrated structural system, supplied by a single manufacturer, consisting of formed aluminum or stainless steel mounting feet and tilt struts.

C. Instrumentation: Use corrosion resistant materials for wetted parts of instruments.
1. Solar Controller: UL listed. Solid-state or electrical only, with overvoltage protection.

a. Differential Temperature Control: Factory assembled and packaged device.
b. Controller Enclosure: NEMA 1.

2. Differential Thermostat: Provide UL-listed differential thermostat for controlling the magnetic starter, not in the same circuit as pump motor.
3. Sensors: Construct sensors to withstand stagnation temperatures of glazed solar collectors. Provide primary and alternate collector sensors attached to an absorber plate. Provide copper wells which can be inserted into the collector tube, storage tank, or pipes. Sensors may be strapped onto pipes and covered with insulation.
4. Pressure Gages: ASME B40.100, brass body, and minimum 90 mm [3.5 inches] diameter dial face.
5. Tank Gages: CID A-A-50568.
6. Thermometers: ASTM E1, dial type, liquid-filled tube and bulb. For pipe and tank applications, provide separate sockets fabricated of brass, copper, or stainless steel and rated for 862 kPa [125 psi] working pressure.
7. Test Ports: Solid brass, 6 mm [1/4 inch] fitting to receive either a temperature or pressure probe 3 mm [1/8 inch] outside diameter, two valve cores of neoprene, fitted with color coded and marked cap with gasket, and rated for 6894 kPa (gage) [1,000 psig].

D. Monitoring System:
   1. Kilojoule Btu Meter: Sensing and Monitoring device to measure and display the heat energy produced by the solar system, with minimum sensitivity of 0.5 percent over the entire scale. Provide electromechanical kJ Btu counter plus digital-panel meter indicating sensor temperatures, differential temperature, flow rate, and watt Btu per minute or hour.

2.5 EXPANSION TANKS

A. Manufacturers: Subject to compliance with requirements.

B. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm and poly-propylene liner. Include air precharge to minimum system-operating pressure at tank.

C. Construction: 150-psig working-pressure rating.

D. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread, brass or stainless steel.

E. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.

F. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.

G. Air-Charging Valve: Factory installed, brass with plastic cap.

H. Floor Mounting Stand: Provide integral floor mounting stand and bottom elbow system connection where vertical, floor-mounted tanks are indicated.

2.6 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: According to the following:

   1. Gas Water Heaters: ANSI Z21.22, combination temperature and pressure relief valve.
   2. Electric and Steam Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
   3. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
   4. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping.

B. Pressure Relief Valves: According to the following:

   1. Gas Water Heaters: ANSI Z21.22 pressure relief valve for storage tanks of 200,000 Btuh.

2. Electric and Steam Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than heat-exchanger working-pressure rating.

C. Vacuum Relief Valves: According to the following:

1. Gas Water Heaters: ANSI Z21.22.
2. Electric and Steam Water Heaters: Comply with ASME PTC 25.3. Furnish for installation in piping.
3. Exception: Omit if water heater has integral vacuum-relieving device.

D. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1, pipe thread.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Water Heater Stand and Drain Pan Units:

1) Safety: W. H. Safety Products, Inc.

E. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.

F. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated, steel bracket for wall mounting and capable of supporting water heater and water.

G. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

H. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.

I. Hose and Drain Valve: Provide with water heater.

J. Install R-10 insulation on concrete pad for electric water heaters.

K. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1 or ASHRAE 90.2.

PART 3 - EXECUTION

3.1 WATER HEATER AND HEAT EXCHANGER INSTALLATION

A. Install water heaters and heat exchangers on concrete housekeeping pads, unless indicated to be suspended.

B. Install water heaters and heat exchangers, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Anchor water heaters and heat exchangers to substrate.

D. Install seismic restraints for water heaters and heat exchangers. Anchor to substrate.

E. Install and connect gas water heaters according to NFPA 54.

1. Install appliance, gas pressure regulators on gas-burner inlets of water heaters without pressure regulators.
2. Install vent piping from gas-train pressure regulators and valves to outside of building where required. Terminate vent piping with brass-screened vent cap fitting. Do not combine vents except with approval of authorities having jurisdiction.

F. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

G. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

H. Install vacuum relief valves in cold-water-inlet piping.

I. Install vacuum relief valves in water heater and heat exchanger storage tanks that have copper lining.

J. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.

K. Install thermometers on water heater and heat exchanger inlet and outlet piping.

L. Install pressure gages on water heater and heat exchanger piping.

M. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet.

N. Arrange for insulation on equipment and piping not furnished with factory-applied insulation.

O. Fill water heaters and heat exchangers with water prior to activation.

P. Charge expansion tanks with air.

Q. In addition to the operating control used for normal water heater operation, install separate high temperature limit that will automatically cut off the fuel supply. The temperature range of the high temperature control shall not allow a setting over 210 deg F (99 deg C.).

1. Gas-Fired Water Heaters: High temperature limit control when actuated shall shutoff the fuel supply with a shutoff means other than the operating control valve.

2. Electric Water Heaters: High temperature limit control when actuated shall cut off all current flow to the burner mechanism.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 21, 22, and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.

D. Connect gas piping to gas burner with drip leg, tee, shutoff valve, and union; minimum size same as inlet connection.

E. Make connections with dielectric fittings where piping is made of dissimilar metal.

F. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service. Ground equipment.

3.3 FIELD QUALITY CONTROL

A. In addition to manufacturer's written installation and startup checks, perform the following:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
2. Verify that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping.
5. Check operation of circulators.
6. Test operation of safety controls, relief valves, and devices.
7. Energize electric circuits.
8. Adjust operating controls.
9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.

10. Balance water flow through manifolds of multiple-unit installations.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters and heat exchangers.

1. Train Owner's maintenance personnel on procedures for starting and stopping trouble-shooting, servicing, and maintaining equipment.
2. Review data in maintenance manuals. Refer to Division 01 Sections.

END OF SECTION 22 33 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes plumbing fixtures and trim, faucets, other fittings, and related components.

1.3 DEFINITIONS

A. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

B. Domestic Water Piping: Piping inside building that conveys potable cold and hot water to fixtures and equipment throughout the building.

C. Non-Potable Water Piping: Piping inside building that conveys non-potable water to fixtures and equipment throughout the building.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

C. Wiring diagrams from manufacturer for electrically operated units.

D. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.

1. Exception: Where fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for this category.

B. Listing and Labeling: Provide electrically operated fixtures and components specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.

B. Store plumbing fixtures on elevated platforms in dry location.

1.7 PROJECT CONDITIONS

A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 BASIC, COMMON FEATURES

A. Components of plumbing fixtures that come in contact with domestic water where under pressure from the distribution system shall be “lead free”.

2.2 PLUMBING FIXTURE STANDARDS

A. Comply with applicable standards and other requirements specified. Plumbing fixtures to be per architectural specification - see architectural drawings and specifications.

1. Emergency Equipment: ANSI Z358.1.
2. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
3. Plastic Laundry Trays: ANSI Z124.6.

4. Plastic Mop-Service Basins: ANSI Z124.6.
5. Plastic Shower Enclosures: ANSI Z124.2 and ANSI Z124.2a.
6. Slip-Resistant Bathing Surfaces: ASTM F 462.
7. Stainless-Steel Fixtures Other than Service Sinks: ASME A112.19.3M.
8. Vitreous-China Fixtures: ASME A112.19.2M.
9. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

2.3 LAVATORY/SINK FAUCET STANDARDS

A. Comply with ASME A112.18.1M and other requirements specified for lavatory, sink, and similar-type-fixture faucet fittings. Include hot- and cold-water indicators; 2.5-gpm- maximum flow rate; and polished, chrome-plated finish; except where otherwise indicated. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
2. Faucet Hose: ASTM D 3901.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
6. Pipe Threads: ASME B1.20.1.
7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
8. Sink Spray Hoses: ASTM D 3573.
9. Public lavatories hot water supply limited to 120 deg F by device conforming to ASSE 1070.

2.4 BATHTUB/SHOWER FAUCET STANDARDS

A. Comply with ASME A112.18.1M and other requirements specified for bathtub and shower faucet fittings. Include hot- and cold-water indicators; 2.5-gpm- maximum flow rate; and polished, chrome-plated finish; except where otherwise indicated. Coordinate faucet inlets with supplies and outlet with diverter valve; tub spout; and shower head, arm, and flange.

1. Combination, Pressure-Equalizing- and Thermostatic-Control, Antiscald Faucets: ASSE 1016.
2. Hand-Held Showers: ASSE 1014.
3. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
4. Hose-Coupling Threads: ASME B1.20.1 or ASME B1.20.7.
5. Manual-Control Antiscald Faucets: ASTM F 444.
6. Pipe Threads: ASME B1.20.1.
7. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
9. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
10. Bathtubs hot water limited to 120 deg F device conforming to ASSE 1070.

2.5 MISCELLANEOUS FITTING STANDARDS

A. Comply with ASME A112.18.1M and other requirements specified for fittings, other than faucets. Include polished, chrome-plated finish, except where otherwise indicated. Coordinate fittings with other components and connectors.

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Automatic Flow Restrictors: ASSE 1028.
3. Brass and Copper, Supplies and Tubular Brass: ASME A112.18.1M.
4. Fixed Flow Restrictors: ASSE 1034.

2.6 MISCELLANEOUS COMPONENT STANDARDS

A. Comply with applicable standards below and other requirements specified for components for plumbing fixtures, equipment, and appliances.

1. Disposers: ASSE 1008 and UL 430.
2. Hose-Coupling Threads: ASME B1.20.7.
3. Hot-Water Dispensers: ASSE 1023 and UL 499.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Shower Receptors: ANSI Z124.2 and ANSI Z124.2a.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Insulation Kits: CABO A117.1.
8. Supports: ASME A112.6.1M.
9. Whirlpool Bathtub Equipment: UL 1795.

B.

2.7 FITTINGS

A. Fittings for Equipment Specified in Other Sections: Fittings include the following:
1. Supply Stops: Chrome-plated brass, angle or straight; compression, same size as supply inlet and with outlet matching supply riser.

2.8 FIXTURE LISTING

A. Refer to drawing schedules for fixture and trim callouts.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Include supports for plumbing fixtures according to the following:

1. For wall hung water closets, urinals, lavatories, sinks.
2. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall
3. Fabricate reinforcement from 2-by-4-inch or 1/4-by-6-inch steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.

B. Include fitting insulation kits for accessible fixtures according to the following:

1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
3. Fixtures with Offset Drain: Cover hot- and cold-water supplies, offset drain, trap, and waste to wall.
4. Other Fixtures: Cover exposed fittings below fixture.

3.3 PLUMBING FIXTURE INSTALLATION

A. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.

B. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.

C. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

D. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

E. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.

F. Install toilet seats on water closets.

G. Install wall-hanging, back-outlet urinals with gasket seals.

H. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.

I. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

J. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

K. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

L. Fasten recessed, wall-mounted fittings to reinforcement built into walls.

M. Fasten wall-mounted fittings to reinforcement built into walls.

N. Fasten counter-mounting plumbing fixtures to casework.

O. Secure supplies to supports or substrate within pipe space behind fixture.

P. Set shower receptors and mop basins in leveling bed of cement grout.

Q. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.

1. Exception: Omit stop valves on supplies to emergency equipment, except when permitted by authorities having jurisdiction. When permitted, install valve chained and locked in OPEN position.

R. Install water-supply stop valves in accessible locations.

S. Install faucet, laminar-flow fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.

T. Install supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

U. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.

V. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

W. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.

X. Install disposers in sink outlets. Install switch where indicated, or in wall adjacent to sink if location is not indicated.

Y. Install hose bibs with integral or field-installed vacuum breaker.

Z. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.

AA. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant according to sealing requirements specified in Division 07 Section "Joint Sealants." Match sealant color to fixture color.

BB. Coordinate exact location and mounting height of all fixtures with the architectural drawings.

3.4 CONNECTIONS

A. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedule on drawings for fitting sizes and connection requirements for each plumbing fixture.

B. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.

C. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Arrange for electric-power connections to fixtures and devices that require power. Electric power is specified in Division 26 Sections.

3.5 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.6 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Include the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

3.8 PLUMBING FIXTURE SCHEDULE

A. Refer to Plumbing Fixture Data Sheets at the end of this section.

B. Provide all options and accessories as indicated.

END OF SECTION 22 42 00

SECTION 22 63 00 - MEDICAL GAS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes Medical Gas Systems consisting of Oxygen O2, and Medical Air MA. These systems shall be installed complete, ready for operation and certified, including all necessary piping, fittings, valves, cabinets, station outlets and inlets, rough-ins, ceiling services, gauges, alarms, cylinder manifolds and all necessary parts, accessories, connections and equipment to satisfy NFPA 99 2005 edition.

1.3 PERFORMANCE REQUIREMENTS

A. System Operating Pressures:

1. Oxygen: 02 deliver 50-55 PSIG/345-380 kPa at outlets.
2. Medical Air: MA deliver 50-55 PSIG/345-380 kPa at outlets.

B. Gas Source:

1. Gas for purging and testing shall be NF nitrogen only.

1.4 SUBMITTALS

A. General: See Section 22 05 00 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.

B. Product Data:

1. Pipe and fittings.
2. Valves and valve boxes.
3. Piping accessories.
4. Medical gas outlets and inlets.
5. Area alarm panels.
6. Master alarm system.
7. Cylinder manifolds.

C. Materials Cleaned for Oxygen Service: Documentation certifying that piping components for all pressure gas systems has been cleaned as if for oxygen service per CGA G-4.1. This includes tubes, valves, fittings, and station outlets.

D. Brazer Performance Qualification: Test records for each brazer used on the installation.

E. System Certification Agency and Test Agenda: Submit the name and qualifications of the medical gas certification agency. The certification agency shall be financially independent of the medical gas equipment manufacturer and the system installer. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequences, procedures for cross connection test, valve test, flow test, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.

F. Precertification Report: Submit the Precertification report as required by the Quality Assurance Article below.

G. Test Reports: At the completion of the project submit pressure test reports with the signature of the witness.

H. System Certification: Submit a document that certifies that the completed systems have been installed, purged, tested and documented in accordance with the requirements of this specification and NFPA 99.

1.5 PROJECT RECORD DOCUMENTS

A. General: See Division 22 Section "Common Word Results For Plumbing" for general requirements of Project Record Documents.

1.6 OPERATION AND MAINTENANCE DATA

A. General: See Division 22 Section "Common Work Results For Plumbing" for general requirements of Operation and Maintenance data submittals.

B. Maintenance Data: Submit a copy of submittal product data, the manufacturer's installation and O&M information and the system certification report.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 99, the UPC latest adopted edition and the Plumbing authority having jurisdiction.

B. Pre-certification Report: Prior to any installation work the Medical Gas System Certification Agency shall review the plans and report any conditions which would prevent them from certifying the system. Any suggested modifications should be included in the report.

C. Brazing Qualifications: Brazing shall be performed by individuals who are qualified per AWS B2.2 or ASME Section IX as modified by NFPA 99.

1.8 COORDINATION

A. Coordinate the work with the structural system, wall / ceiling framing and device installations, and wall / ceiling installations of other trades.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Pipe): Pipe shall be hard drawn seamless medical gas tubing, ASTM B819, which is factory prewashed and capped. Use Type L for oxygen, medical air. Use Type K for any med gas pipe indicated to be underground. All piping shall be labeled "OXY, MED" with the ASTM number. The minimum size shall be 1/2-inch except for connection to outlets.

B. Fittings: Fittings shall be wrought copper, ASTM B16.22, especially prewashed and bagged for medical gas service. Fittings shall be long radius type.

C. Joints: Joints shall be brazed using Sil-Fos or other self-fluxing silver brazing alloy with an 1190 degrees F minimum melting point per ANSI/AWS A5.8 and NFPA 99. All brazing shall be done utilizing a nitrogen purge. Where threaded joints are required for connection of equipment and or gauges, oxygen safe Teflon tape or oxygen safe thread dope (Floromatic formula 8 or Expando) shall be used. The Teflon tape shall be as manufactured by the Mill Rose Company. It shall be a special oil free PTFE oxygen thread seal tape.

D. Pipe and Fittings for Medical Air Compressor Intake Piping: Provide same as Medical Air Piping.

E. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.

2.2 VALVES

A. Manufacturers:

1. Allied Healthcare.
2. BeaconMedaes.
3. Squire Cogswell.
4. Tri-Tech.
5. Amico.
6. Nibco.
7. Stockham.
8. Grinnell.
9. Milwaukee.
10. Apollo.

B. Ball Valves (4-inch and Smaller) (Except MV and WAGD): Brass or bronze body 3 piece bolted construction, full port, 600 PSIG W. O. G., TFE seats and seals, chrome plated brass ball with brass blow-out proof stem. Handles shall be equipped with mechanism to lock valve open utilizing an owner-furnished padlock. Valves shall be cleaned for oxygen service. Valves shall have Type K copper tubing extensions brazed to valve sweat connection ends. At contractor

option, tubing extensions may be provided by the contractor provided that an approved procedure is submitted. The downstream tubing extensions shall have a 1/4-inch FPT gauge port with plug. Where provided at main line service shutoff valves (other than zone valve boxes) provide the valve with an additional upstream 1/4-inch gauge port to facilitate purging.

2.3 PIPING ACCESSORIES

A. Flexible Connectors: Manufactured specifically for operating pressures and temperatures. Provide corrugated bellows type, stainless steel, with solid pipe extensions at each end. End connections shall be sweat fit for pipelines in the building and threaded at equipment. Provide with stainless steel or bronze wire double braided outer reinforcing over bellows. Use manufacturers recommended length for the intended service. For Positive pressure medical gas systems and medical air compressor intake piping flexible connectors shall be cleaned for oxygen service.

B. Gauges:

1. Manufacturers:

   a. Allied Healthcare.
   b. BeaconMedaes.
   c. Squire Cogswell.
   d. Tri-Tech.
   e. Amico.

2. Requirements:

   a. 4-1/2-inch diameter pressure and vacuum gauges, stainless steel case with plastic lens, 1/4-inch NPT male connection made of brass, soft soldiered phosphor bronze tube internals.
   b. White background with black graduation markings.
   c. Accuracy shall be within 1/2% of scale range.
   d. Provide 0-100 psig range for positive pressure gasses, 0-200 psig range for Nitrogen and 0-30 inch HG range for vacuum applications. Gauges for positive pressure shall be cleaned for oxygen service.

3. Basis of design: Allied Healthcare Models 77-90-0591 thru 0598.

2.4 MEDICAL GAS OUTLETS AND INLETS

A. Manufacturers:

1. Allied Healthcare.
2. BeaconMedaes.
3. Squire Cogswell.
4. Tri-Tech.
5. Amico.

B. Type and Style: DISS modular wall and or ceiling outlets or Quick Disconnect wall outlets complying with NFPA 99.

2.5 AREA ALARM PANELS

A. Manufacturers:

1. Allied Healthcare.
2. BeaconMedaes.
3. Squire Cogswell.
4. Tri-Tech.
5. Amico.

B. Requirements:

1. Recessed with surface mounted cover, NFPA 99 compliant, UL listed, 120 volt (1 amp) single phase primary power, low voltage control wiring, integral transformer, pressure transducer for each gas mounted in panel with gas specific quick disconnect connection to gas piping.
2. The quick disconnect fitting and pipe connection to the pressure transducer shall be designed for easy removal of the transducer for annual functionality tests.
3. The gas pressure for each gas shall have a LED display in PSIG (or inch HG for vacuum).
4. Alarm limits shall be set at NFPA limits.
5. Provide Type K tubing extensions from panel.
6. All pipe and transducers shall be cleaned for oxygen service.
7. Provide alarm horn, light, horn silence button, and push to test button.
8. In a power failure situation the panel shall not alarm nor shall a manual reset be required upon restoration of normal power.
9. The panel shall be modular and shall accommodate from 1 to 6 gas systems.
10. The actual panel size shall be for only the number of gasses indicated.

2.6 MASTER ALARM SYSTEM

A. Master Alarm Pressure Switches: Provide Allied Health Care Model Number 74-13-0100 Series for sensing both vacuum and low and high pressure alarms. Provide with contacts for two alarm circuits. Alarm contacts shall be closed when the switch is in the pressurized normal pressure range. The same alarm contacts shall be opened when the pressure goes above or below the normal pressure range. Provide quick disconnect fitting for installing the switch. Compliant with NFPA 99 and UL listed. Alarms switches shall be set to alarm at levels required by NFPA 99.

1. Other Approved Manufacturers:

a. BeaconMedaes.
b. Squire Cogswell.
c. Tri-Tech.
d. Amico.

B. Master Alarm Panels (Digital Non-Gauge):

1. Manufacturers:

a. Allied Healthcare.

b. BeaconMedaes.
c. Squire Cogswell.
d. Tri-Tech.
e. Amico.

2. Requirements:

a. Recessed with surface mounted cover, NFPA 99 compliant, UL listed, 120 volt single phase primary power, 5 VDC low voltage control wiring, integral rectifier.
b. Alarm panel shall display alarm light and sound audible alarm when the specific alarm circuit is opened by either, alarm switch / contact device or a break in the alarm wiring circuit.
c. Each alarm circuit shall display an LED red light for alarm condition and shall display a green LED light for normal condition.
d. Adjacent to each pair of status lights there shall be a label for each alarm.
e. Provide alarm horn, horn silence button, and push to test button.
f. The panel shall not include a pressure display for specific gas pressures.
g. Each alarm circuit shall have spare contacts for remote monitoring of alarm thru the building automation DDC system.
h. These contacts shall be electrically isolated from the 5 VDC master alarm system.
i. In a power failure situation the panel shall not alarm nor shall a manual reset be required upon restoration of normal power.
j. The panel shall be modular and shall accommodate 36 alarm signals.

3. Basis of Design: Allied Healthcare Model **[74-14-XXXX]** Series.

C. Wiring: See Part 3 of this section. Coordinate accordingly.

2.7 CYLINDER MANIFOLDS

A. Manufacturers:

1. Allied Healthcare.
2. BeaconMedaes.
3. Squire Cogswell.
4. Tri-Tech.
5. Amico.

B. Requirements:

1. General: Automatic change over cylinder manifold system for use with high pressure gas cylinders. The manifold shall be NFPA compliant, UL listed and 120 volt (1 amp) single phase power requirement.
2. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder bank header. In a power failure situation the manifold shall not alarm nor shall a manual reset be required upon restoration of normal power.
3. Product Requirements: Wall mounted manifold consisting of sheet metal housing with indicator lights, alarm lights, alarm horn with silence button, one delivery (low pressure side) and two supply (high pressure side) pressure gauges mounted in panel face, manifold bar shutoff valves to left and right side of the cabinet. The delivery connection

to the building system shall be on top and shall not be less than ¾" in size. A relief valve connection shall also be on top of the cabinet. The inside of the cabinet shall include primary and secondary pressure regulators for right and left sides, pressure switches, check valves, relief valves, selector valves, all pre-piped, cleaned for oxygen service and tested in accordance with NFPA 99. Provide high pressure manifolds with 24 inch long flexible stainless steel cylinder pigtail connections. Each pigtail shall include an integral check valve. Design pressure shall be 3000 psig on the high pressure manifolds and valving.

4. Master Alarm Functions: The manifold shall have alarm lights and a horn which shall illuminate and annunciate when either of the following conditions occur. At the point when the primary bank is exhausted and the reserve is in use. At the point where the reserve high pressure manifold no longer has sufficient pressure to provide one days reserve capacity. Provide contacts for these two alarms for connection to the master alarm system. These contacts shall be electrically isolated for the 5 VDC master alarm system. The contacts shall be normally closed when the system is in the normal condition. An alarm horn silence button shall be provided on the front of the panel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning: Handle all piping to prevent entry of dirt and contaminants. Factory-cleaned and sealed piping, cleaned as specified herein, shall have ends kept sealed until immediately ready for use. Provide temporary caps for all pipes and stations during construction. Comply with NFPA 99 regarding special washing, cleaning and flushing required before erection.

3.2 INSTALLATION

A. Cutting and Fitting: Cut tubing with a tubing cutter (sawing is not permitted), debur end of tubing and remove any chips. Blow out tube with nitrogen prior to assembly into the system.

B. Joint Preparation: Clean surfaces to be brazed with a clean stainless steel brush or 3M Scotchbrite pad (sanding cloth is not allowed). Do not use steel wool as it may contain oil. After mechanical cleaning the surfaces shall be wiped using a clean, lint-free white cloth. Joints shall be brazed within one hour of being cleaned.

C. Brazing: All joints shall be brazed by qualified brazers. A nitrogen purge shall be used during brazing and until the joints are all cool to the touch. After brazing wash the outside of each joint with a wet rag and a wire brush. The use of flux is prohibited except when brazing copper to brass. In such cases the pipe interior shall be re-cleaned after brazing.

D. Pipe Bending: Field bends in piping are not permitted.

E. Pipe Isolation: Isolate copper tubing from contact with dissimilar metal contact using 10 mil PVC tape or plastic grommets. Medical gas piping shall not be used as a part of an electrical grounding system.

F. Hangers: Individual hangers 4-inch and less shall be copper band hangers with steel adjustable swivel nut per MSS SP-69. Larger pipes may be steel clevis type with tape or felt liner to

isolate med gas pipe from dissimilar metal. Support hangers on steel all-thread rod. Trapeze hangers of Unistrut with individual clamps for each pipe are acceptable provided PVC tape is used to isolate the med gas pipe from dissimilar metal. Hanger strap is not allowed.

G. Install hangers copper tubing with the following maximum spacing:

Nom. Pipe Size (Inches)	Copper Tube Max. Span (Feet)
1/2”	6
3/4”	7
1”	8
1-1/4”	9
1-1/2” and Up	10

H. Riser Supports: Tubing risers shall be supported at each floor but in no case shall the support distance exceed 15 feet. In such cases or where pipe size is less than 2-inches provide additional intermediate floor support from other vertical surfaces or from supplementary steel support rack. Riser clamps shall be MSS Type 8 or 42 clamps. Pipe drops in general shall be anchored to walls, floors or other structure.

I. Pipe Slope: In general, horizontal piping for Medical Vacuum and WAGD systems shall slope toward the vacuum source. Provide drains at low points of the piping system. Drains shall consist of two ball valves in series, with 6-inch vertical dirt leg in between valves, to enable drainage while isolating the dirt leg from vacuum system. Provide pipe plug on outlet of downstream ball valve.

J. Piping Identification: Identify all piping as required.

K. After installation of the piping and before installation of outlets, all pipe lines shall be blown clean with nitrogen.

L. Purge Ports: At all mainline shutoff valves which serve more than 1 room, and which are not located in a zone valve box, install purge ports on both sides of the valve to facilitate purging during initial installation or future system changes. The purge ports shall consist of either of the following:

1. Provide a 1/2-inch tee with a female adapter and a brass plug.
2. Provide valves as specified with 1/4-inch gauge ports and plugs.

M. Outlet Support: Provide backing as required to firmly attach outlets to wall and/or ceiling framing. Ceiling backing shall be sturdy enough to support a 10 pound load on the outlet without noticeable deflection of the ceiling or the outlet.

N. Protection: Exposed piping in areas subject to physical damage by carts, stretchers, portable equipment, or vehicles shall be protected with steel barriers.

O. Shutdowns: Prior to submitting a shutdown request determine the areas effected by the valves(s) being shutdown. Submit the shutdown request for approval.

P. Connections to Existing Systems: Final tie-in connections to existing systems shall be leak tested with source gas at normal operating pressures. Maintain pressure while each new joint is

examined for leakage with soapy water. Do not connect to existing system until the following are done.

1. Installer's tests are complete (see below).
2. Part of the certification agency's tests are complete up to and including piping purity test (see below).

Q. Cylinder Manifolds: Securely fasten manifold to wall and install cylinder manifolds per manufacturer's installation instructions. Test cylinder manifold connection piping at 2000 psig and perform soapy water test at each joint. Arrange for first set of cylinders to be delivered to manifold room by owner. Connect initial set of primary and reserve cylinders. Verify auto changeover controls function. Assist electrician in connecting alarm wiring to correct terminals.

R. Underground Piping: Underground piping shall be installed inside schedule 40 PVC pipe of a size that allows approximately 0.75-1 inch of annular space all around between the two pipes. Provide plastic grommets to space the interior pipe in the middle of the carrier pipe. Cut PVC pipe longitudinally as required to install and test the medical gas piping prior to covering. Tape the PVC pipe up water tight and pour concrete around pipe. Concrete shall extend a minimum of 6-inches above, below and to both sides of the piping. The minimum depth of bury to top of concrete shall be 18 inches. Provide buried utility warning tape (6-inches wide polyethylene with continuous lettering stating "WARNING – BURIED OXYGEN") along the length of the concrete located 6-inches above the concrete.

S. Master Alarm Wiring: Master alarm wiring shall be under Divisions 26 or 27. All wiring shall be in accordance with the alarm panel manufacturer's instructions and shall be in accordance with Division 26 and 27 specifications. Coordinate accordingly. All wiring shall be in conduit. Alarm wire shall be 22 gauge AWG for up to 2000 foot wire lengths. Coordinate with alarm panel installation instructions. Master alarm circuits shall be wired so they are normally energized (supervised) circuits in the non-alarm state. Wire the alarm switch contacts so the contacts are closed in the normal "non-alarm" state. Any break in the circuit shall cause the master panel to go into alarm. Wiring shall be totally redundant such that a break in a wire to one alarm panel will only show up on that panel. Pull four wires per alarm signal (a pair for each master panel) and splice down to two wires in a j-box within a couple feet of the alarm contact switch. Junction boxes shall have wiring terminal strips (no wire nuts allowed). All wire shall be identified by color or by labels as to the specific alarm it serves. Provide a schedule of wires and alarms. All master alarm 120 volt power shall be life safety emergency power per NFPA. All master alarm power shall be life safety emergency power per NFPA. **[This paragraph shall be used for Division 26/27 wiring.]**

T. Master Alarm Wiring: Master alarm wiring shall be under this section. All wiring shall be in accordance with the alarm panel manufacturer's instructions and shall be in accordance with Division 26 and 27 specifications. Coordinate accordingly. All wiring shall be in conduit. Alarm wire shall be 22 gauge AWG for up to 2000 foot wire lengths. Coordinate with alarm panel installation instructions. Master alarm circuits shall be wired so they are normally energized (supervised) circuits in the non-alarm state. Wire the alarm switch contacts so the contacts are closed in the normal "non-alarm" state. Any break in the circuit shall cause the master panel to go into alarm. Wiring shall be totally redundant such that a break in a wire to one alarm panel will only show up on that panel. Pull four wires per alarm signal (a pair for each master panel) and splice down to two wires in a j-box within a couple feet of the alarm contact switch. Junction boxes shall have wiring terminal strips (no wire nuts allowed). All wire shall be identified by color or by labels as to the specific alarm it serves. Provide a schedule of wires and alarms. All master alarm 120 volt power shall be life safety emergency power per NFPA. 120

volt power shall be provided to the master panels under Division 26. **[This paragraph shall be used for Division 22 wiring.]**

U. Service Valves and In-line Valves: For each medical gas service or in-line valve, as defined by NFPA 99, provide a padlock that is common keyed per facility standards. Lock each valve in the open position per NFPA 99.

V. Valves for Future Connections: For each medical gas valve installed for a future connection, as defined by NFPA 99, provide a padlock that is common keyed per facility standards. Lock each valve in the closed position per NFPA 99. Extend pipe past the tubing extension on the downstream side of the valve and braze a cap on. See paragraph above on purge ports.

3.3 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

A. Do not interconnect medical gas pipelines. Perform pressure testing with individual pipe system charging and measurement for each system.

B. After installation of shutoff valves and outlets, but before installation of system components (switches, gauges, alarms, manifolds, etc.) each section of the new piping system shall be subjected to a test pressure of 1.5 times the working pressure, but not less than 150 psig, by means of oil free, dry nitrogen. This test pressure shall be maintained until each joint has been examined for leakage by means of soapy water. All leaks shall be repaired and the section retested.

C. After completion of the above test procedure the finishing assemblies of station outlets, alarms, and all components (e.g. pressure switches, gauges, relief valves, etc.), except those for Vacuum, shall be installed and all medical gas piping systems shall be subjected to a 24 hour standing pressure test at 20% above the normal operating line pressure. Use oil free, dry nitrogen for test gas. The source shutoff valve shall be closed during this test. Pressure gas systems are to remain leak free. Vacuum is to be subjected to a test pressure of 60 psig. Vacuum test pressure at the end of 24 hours is to be within 5 psig of initial test pressure. Any leaks shall be located, repaired, and systems retested.

D. Attach vacuum alarm switches and vacuum gauges to the medical vacuum system. Perform vacuum tests on each zone. Subject piping to a vacuum in excess of 12-inches Hg. Close valves to areas tested. The loss of vacuum is to be less than 1-1/2-inches Hg in a one hour period.

E. Blowdown each pressure gas system in order to remove particulate matter in pipelines. A high flow, intermittent purge shall be put on each outlet using appropriate adapters. Continue until purge produces no discoloration in a white cloth.

F. To determine that no cross connections to other pipeline systems exist, reduce all systems to atmospheric pressure. Disconnect all sources of test gas from all of the system with the exception of the one system to be checked. Pressure this system with oil-free dry nitrogen to a pressure of 50 psig. With appropriate adapters matching outlet labels, check each individual station outlet of all systems installed to determine that test gas is being dispensed from only the outlets of this system.

G. Disconnect the source of test gas and reduce the system tested to atmospheric pressure. Proceed to test each additional pipeline system in accordance with the procedure outlined above. Vacuum systems can be tested with vacuum instead of pressure.

H. Pressure tests should be witnessed by a representative of the hospital. The installing contractor shall supply written documentation that the pressure tests have been completed and the systems meet these specifications.

I. After 24 hour standing leakage testing is completed, allow piping to remain pressurized with test gas until certification agency performs final tests.

J. Vacuum Vent Pipe Test: Cap pipes at the vacuum pumps and fill with water to the roof terminus. There shall not be any perceptible drop in water level or any noticeable leaks over a 2 hour period.

K. Medical Air Compressor Suction Piping Test: Test with nitrogen at 25 psig for 24 hours with no perceptible drop in pressure.

3.4 CERTIFICATION AGENCY TESTS

A. System verification is to be performed by the approved medical gas certification agency. Verify that systems, as installed, meet or exceed the requirements of NFPA 99, 2005 and this specification and that systems operate as required.

B. Hoses are to be installed in rail systems and hose drops for certifier's outlet tests.

C. Medical gas concentration analysis is to be performed with instruments designed to measure the specific gas dispensed.

D. Perform and document all tests required in NFPA 99, 2005; 5.1.12.3.

1. Cross connection.
2. Valve test.
3. Outlet flow and pressure drop.
4. Master alarms.
5. Area alarms.
6. Piping purge with a .45 micron filter.
7. Piping purity.
8. Final tie-in and blowdown of existing piping.
9. Operational pressure test with source gas.
10. Medical gas concentration.
11. Medical air purity.
12. Labeling of outlets, valves, and alarms.
13. Source equipment operation.

E. Problem Resolution: Any discrepancies discovered during the inspection shall be noted and corrected. All portions of the system affected by corrective action shall be retested and findings recorded after retest.

F. Final Certification Report: Record results of certification tests and submit report with O&M manual.

3.5 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain medical gas alarm system. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 63 00

SECTION 23 05 00 – COMMON WORK FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings. Dielectric fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   6. Escutcheons.
   7. Grout.
   8. Equipment installation requirements common to equipment sections.
   9. Painting and finishing.
   10. Concrete bases.
   11. Supports and anchorages.

1.3 GENERAL PROVISIONS

A. Examine drawings relating to work of all trades and become fully informed as to the extent and character of work required.

B. Before submitting bid, Contractor shall examine all conditions and work of other trades on which his work is in any way dependent for the best workmanship and operation, according to the intent of the specifications and drawings, taking into account at the same time, the complexity of the project. He shall report to the Architect any conditions which might prevent him from installing his equipment in the manner intended or contrary to applicable ordinances or regulations.

C. All work shall be completed in a workmanlike manner, and shall conform to best trade practice.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sustainability Design Coordination:

1. Contractor shall comply with recycling requirements in Division 01 “Construction Waste Management”.

2. Contractor shall comply with dust and pollutant control requirements in Division 01 “Construction IAQ”.

3. Products in this section may also be required to comply with VOC limits, recycled content, regional materials, or other green goals described in Division 01 “Sustainable (LEED) Construction Requirements”.

4. Provide written notification to the Architect of any nonspecified items used in the work of this Section that contain or include

a. liquid chemicals, adhesives, sealants, paints, coatings, or tapes containing VOC's or other toxins;

b. composite wood or agrifiber that may contain urea formaldehyde binders.

1.5 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.6 INTENT

A. It is the intention of the specifications and drawings to call for finished work, tested, and ready for operation. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories required to make the work complete in all respects and ready for operation shall be furnished, delivered and installed by the Contractor without additional expense to the Owner.

1.7 CODES, RULES, PERMITS AND FEES

A. Nothing contained in this Specification or shown on the Drawings shall be so construed as to conflict with the standards of the National Fire Protection Association, or any local, municipal, State or Federal regulation governing the installation of the work specified herein, and the requirements of same. All such laws, ordinances and regulations, where they apply to this work, are hereby incorporated into and made a part of this Specification. Where applicable, materials, and equipment shall bear stamps or seals of UL, ASME, NEMA, and other industry-regulating groups. In case of difference between governing codes, specifications, laws, ordinances, industry and utility regulations, or contract documents, the most stringent shall govern. Contractor shall promptly notify Architect, in writing, of such differences.

1.8 DRAWINGS

A. Drawings are diagrammatic, and indicate the general arrangement of systems and work included in the contract. Consult the Drawings and details, for exact locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect. The right is reserved to make minor changes in locations up to the time of roughing in without additional charge to the Owner.

B. The Drawings have been made to scale with the best knowledge of conditions, dimensions and space requirements available at the time of drafting, and shall be followed as closely as actual building construction and the work of other trades will permit. Any errors or discrepancies detected in the Drawings shall be reported to the Architect immediately upon discovery for attention and instructions as to further procedure.

C. Check Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.

D. If directed by the Architect, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with the work of other trades, or for proper execution of the work.

E. Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts between the structural and architectural drawings shall be reported to the project architect. Owner will take no responsibility for conflicts which were not reported before commencement of mechanical work.

F. Equipment furnished shall fit in allocated space with due provision for manufacturer's recommended access and maintenance requirements. Verify and coordinate space requirements with all trades and equipment which comprise the Work.

G. Piping Diagrams:

1. Piping and other flow diagrams which appear on the Drawings are provided with the intention of showing equipment, pipe, valves, specialties and other appurtenances in their proper interrelation. Provide and connect all additional equipment, pipe, valves, specialties and appurtenances required by the manufacturer of the equipment furnished for proper operation of his product, whether or not shown, or as required elsewhere in the Specifications, e.g., drain valves, air vents, unions, pipe nipples, and similar items. In the event of discrepancies between the Piping Diagrams and the plans or elevations shown on the Drawings, the Piping Diagrams shall govern. Notify the Architect in writing of any discrepancy.

1.9 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new, shall bear manufacturer's name, and shall conform to the grade, quality and standards specified herein. Type, capacity and application shall be suitable and capable of satisfactory operation for the purpose intended.

B. All materials and equipment shall be adequately covered and protected against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption if occupied or scheduled for occupancy. Material delivered at the site shall not be left exposed to the weather or left unattended.

1.10 QUALITY ASSURANCE

A. Listing and labeling: Provide motors specified in this Section that are listed and labeled.

1. Terms "listed and labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory".

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.12 ELECTRICAL WIRING AND COORDINATION

A. In general, power wiring will be provided under DIVISION 26 -ELECTRICAL, and control wiring will be provided under DIVISION 23 – MECHANICAL, unless otherwise specified.

B. Electric wiring provided under DIVISION 26 shall be in accordance with the requirements of DIVISION 26.

C. Except where noted otherwise, control wiring under DIVISION 23 shall include all connections to control devices, interlock wiring, control relays, sensing devices, etc. incidental to the building automation system and the proper operation of equipment provided under Division 23.

D. Control Voltage:

1. Maximum allowable control voltage shall be 120 VAC. Fully protect control circuit conductors in accordance with National Electrical Code. Control transformers shall be provided with two primary fuses and one secondary fuse.
2. Fully coordinate the requirements of each Division with regard to providing a complete DDC Building Automation System. Junction boxes and control transformer connections shall be provided under Division 26.

E. Carefully coordinate the interface between the Work of Division 22, 23 (Mechanical), and Division 26 (Electrical) before submitting any equipment for review or commencing installation.

F. The following schedule summarizes the division or work and material responsibilities between Division 23 and 26.

ITEM	FURNISHED UNDER	SET IN PLACE OR MOUNTED UNDER	WIRED AND CONNECTED UNDER
Equipment motors	MD(1)	MD(1)	ED(2)
Fire protection controls, including remote switches, flow switches.	MD	MD	ED
Motor controls where specified as an integral package.	MD	MD	ED
Motor contollers.	ED(4)	ED(4)	ED
Magnetic contactors and magnetic starters with overload trip assembly.	ED(4)	ED(4)	ED
Integral control transformers.	MD(6)	ED(4)	ED
Cover-mounted control devices.	MD(6)	ED(4)	ED
Manual motor starters with overload trip assembly.	ED(4)	ED(4)	ED
Motor starter swtiches.	ED(4)	ED(4)	ED
Disconnect switches fused and unfused.	ED(4)	ED(4)	ED
Thermal or thermal-magnetic circuit breakers.	ED(4)	ED(4)	ED
Fuses.	ED(4)	ED(4)	ED
Duct smoke detectors.	ED	MD	ED(3)
Smoke and fire/smoke dampers (with and without end switches).	MD	MD	ED(3)
Control power source for temperature and equipment control panels.	ED	ED	ED
Electric temperature control relays and miscellaneous devices.	MD	MD(5)	MD(5)
Level and float switches.	MD	MD(5)	MD(5)
Pipe mounted control devices such as flow switches, flow sensors, valves, and wells.	MD	MD(5)	MD(5)
Thermostats and space sensors.	MD	MD(5)	MD(5)
Duct mounted control devices such as temperature, humidity, flow and pressure sensors.	MD	MD(5)	MD(5)
Damper actuators.	MD	MD(5)	MD(5)
Control dampers.	MD	MD	--
Variable frequency drives (VFD) specified to be mounted on or in the mechanical equipment.	MD	MD	ED

ITEM	FURNISHED UNDER	SET IN PLACE OR MOUNTED UNDER	WIRED AND CONNECTED UNDER
VFD specified to be mounted separately from the mechanical equipment.	MD	ED	ED

Notes:
(1) MD: Mechanical Division 22, 23.
(2) ED: Electrical Division 26.
(3) Fire alarm-related and power wiring provided under Division 26; Control-related wiring and relays provided under Division 22, 23.
(4) If furnished as part of factory equipment under Division 22, 23, wiring and connections only by Electrical Division 26.
(5) If any control devices carry the Full Load Current to any motor, they shall be furnished under Division 22, 23, but shall be set in place and connected under Division 26.
(6) Except where indicated as part of a motor control center on the Electrical Drawings.
(7) Division 26 shall provide the logic contact closure and the wiring to the local DDC temperature control panel. Division 26 shall also provide interface with the fire alarm system, proof of flow devices (duct/fan air flow switches), connecting wiring, smoke control logic, panel, relays, damper monitoring, and associated devices for a complete smoke control system.

1.13 ACCESSIBILITY

A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated or maintained, in fully accessible positions. Such equipment shall include, but not be limited to, valves, traps, clean-outs, motors, controllers, drain points, etc. Provide sufficient access space for: all equipment (e.g., VAV boxes control and damper devices, reheat coil and fan powered units, AHU cooling and heating coils, fire damper access doors and ability to change the linkage, all low point drain valves, heating and cooling coil vents, prefilter and final filter removal, etc.). Equipment requiring periodic maintenance, shall be installed to permit removal without damage to other work. If required for better accessibility, provide access doors for this purpose. Provide access door to the upstream side of turning vanes and all other equipment and devices requiring maintenance and replacement. All equipment requiring lubrication shall have an accessible external grease fitting for maintenance purposes. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect.

1.14 OPERATING INSTRUCTION

A. The Contractor shall provide an experienced Operating Engineer competent to instruct the Owner or Owner's Representative in the operation and care of equipment installed under this Contract. Provide minimum time as required under each section of the contract.

1.15 OPERATING AND MAINTENANCE MANUALS

A. At the completion of the project, or as otherwise directed, deliver to the Architect required sets per Division 1 of instruction manuals for each piece of equipment, controls, valves, and all specialty items.

B. Include in each instruction manual data supplied by the manufacturer, giving complete information as specified in Division 1.

1.16 AS-BUILT DRAWINGS

A. Contractor shall keep at the site one set of drawings on which all changes in location of equipment, piping, ductwork, and electrical work shall be recorded. All notations shall be neat, legible and in red ink.

B. Electronic documentation shall be generated to include field modifications by CAD. Drawing changes shall be included in consistency with the standard drawing convention as determined by the architect.

C. Upon completion, and prior to acceptance of the work, Contractor shall furnish the marked drawings and electronic drawing files to the Architect. Refer to Division 1 for additional requirements.

D. Should the contractor request an electronic version of the contract documents, then a fee will be required per sheet for this service payable to the consultant.

1.17 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

C. Sustainability:

   1. Contractor shall bring to the attention of the Architect any items not specified herein that are required for construction and may contain liquid chemicals, coatings, or tapes containing VOC's or other toxins, composite wood or agrifiber that may contain urea formaldehyde binders.

1.18 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If

minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.19 VOLTAGE VERIFICATION

A. Before furnishing electric motors and other equipment that includes electrical operated components, the Contractor shall verify that the voltage, phase and hertz ratings conform to the electrical characteristics of the circuits shown for the equipment on the Electrical Drawings.

1.20 MANUFACTURER'S SERVICES FOR EQUIPMENT START-UP

A. The Contractor shall arrange to have the manufacturers of all major items of equipment perform start-up and check-out service and shall provide a letter from each manufacturer. The letters shall be on the manufacturer's letterhead, shall list the equipment, shall certify that the equipment has been examined, that it has been installed in accordance with the manufacturer's installation instructions, started up, adjusted, and checked out in accordance with the manufacturer's instructions, and is operating properly. The letter(s) shall be addressed to the Owner and shall be signed by an authorized representative of the manufacturer(s). The equipment checked and certified shall be all items in the following list or specified in other sections to have manufacturer's start-up service:

1. Air handlers, air conditioners, fans.
2. Other major equipment as indicated in other specification sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22, 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22, 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Dresser Industries, Inc.; DMD Div.
      c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
      d. JCM Industries.
      e. Smith-Blair, Inc.
      f. Viking Johnson.
      g. Or equal
   2. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Div.
      e. Zurn Industries, Inc.; Wilkins Div.
      f. Or equal

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.

c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.
e. Or equal

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Or equal
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
a. Calpico, Inc.
b. Lochinvar Corp.
c. Or equal

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
1. Manufacturers:
a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.
e. Or equal

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Or equal
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Pipes Passing Through Walls and Footings: Schedule 40 black steel pipe or Schedule 40 PVC. For waterproof sleeves, use Thunderline Link-Seal or Calpico Sealing Linx. Where required, also install pipe plug material – De Neef or equal.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
      h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes except for wet areas.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation except where building separations or seismic joints require additional. Use the following sleeve materials:
    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section for flashing.
        1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations details on the drawings. Refer to Division 7 Section for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable “100% lead-free” flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using 100% lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in other sections.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases and form equipment anchorages as detailed in the structural drawings.
2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use concrete and reinforcement as specified in Division 3 Sections and the Structural Drawings.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 23 05 66 – ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI) LIGHT FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. This Section includes ultraviolet germicidal irradiation light fixtures for providing infection control support and occupant safety provisions.

C. Product Data: For each fixture indicated, include equipment selection with noted location

D. Shop Drawings: Show layout of unit placement, include detailed layout of location (placement and height) to coordinate with architecture, lighting, and structure.

E. Maintenance Data: Provide maintenance requirement summary, service schedule outline, and service procedure overview/training for facility engineers.

1.02 COORDINATION

A. Coordinate layout and specific fixture location with architect and structural engineer.

B. Coordinate electrical connections with electrical subcontractor.

PART 2 - PRODUCTS

2.01 Fixture Type

A. Indirect Ultraviolet Air Disinfection Fixture, Model LIND 24-EVO

B. Manufacturer: Hygeair, Atlantic, Aeromed, or equal

PART 3 - EXECUTION

3.01 FIXTURE INSTALLATION

A. The fixture is to be mounted on a plumb, vertical surface, at a minimum height of 7 feet from the floor

3.02 FIELD QUALITY CONTROL

A. Test fixture performance to ensure adequate output/distribution and that the louvers sufficiently prevent irradiation to occupants (skin/eyes)

3.03 CLEANING

A. Before installing UVGI fixtures, clean tubes, louvers, and housing.

END OF SECTION

SECTION 23 23 00 – REFRIGERANT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

B. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

C. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

D. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 01.

1.03 QUALITY ASSURANCE

A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.04 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section.

D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for fire stopping specified in Division 7 Section for materials and methods for sealing pipe penetrations through fire and smoke barriers.

E. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.01 TYPE L COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver)

E. Flexible Connectors: 500-psig minimum operating pressure; seamless tin-bronze core, high-tensile bronze-braid covering, and solder-joint end connections; dehydrated, pressure tested, minimum 7 inches long

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Aboveground, within Building: Type ACR drawn-copper tubing.

3.02 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE Standard 15.

B. Basic piping installation requirements are specified in Division 23 Section "Common Work Results for HVAC."

C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

G. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

H. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.

I. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

J. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports."

K. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.

L. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 3/8 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 3/8 inch.
   3. NPS 1: Maximum span, 72 inches; minimum rod size, 3/8 inch.
   4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

M. Support vertical runs at each floor.

N. Provide vibration isolation in accordance with Section 23 05 48 Vibration, Seismic Controls for HVAC Piping and Equipment.

3.03 PIPE JOINT CONSTRUCTION

A. Braze joints according to Division 23 Section "Common Work Results for HVAC."

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.04 FIELD QUALITY CONTROL

A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

3.05 CLEANING

A. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

END OF SECTION

SECTION 233100 – METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 4-inch wg. Metal ducts include the following:
   1. Rectangular ducts and fittings.
   2. Single-wall, round, spiral-seam ducts and formed fittings.

B. Related Sections include the following:
   1. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
   2. Section 01 74 19 for recycling requirements.
   3. Section 01 81 15 for dust and pollutant control requirements.
   4. Section 01 81 13 for VOC limits, recycled content, regional materials, and other sustainable design requirements

1.03 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sustainability Design Coordination:
   1. Contractor shall comply with recycling requirements in Division 01 “Construction Management”.
   2. Contractor shall comply with dust and pollutant control requirements in Division 01 “Construction IAQ”.
   3. Provide written notification to the Architect of any non-specified items used in the work of this Section that contain or include:
      a. Liquid chemicals, adhesives, sealants, paints, coating, or tapes containing VOC’s or other toxins.
      b. Composite wood or agrifiber that may contain urea formaldehyde binders.

1.05 SUBMITTALS

A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot (1:50) scale. Show fabrication and installation details for metal ducts.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevations of top and bottom of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints - per related Notes on Structural Drawing S-911.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.

D. Field quality-control test reports.

E. Sustainable Design Submittals
1. Contractor shall bring the attention of the Architect any items not specified herein that are required for construction and may contain liquid chemicals, coatings, or tapes containing VOC’s or other toxins, composite wood or agrifiber that may contain urea formaldehyde binders.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports, AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members, and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.01 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

D. Stainless Steel: ASTM A 480/A 480M, Type 304. For grease duct use Type 316.

E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts. One gauge heavier than sheet metal duct.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.03 DUCT LINER

A. No liner in systems serving patient areas.

B. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
   1. Manufacturers:
      a. CertainTeed Corp.; Insulation Group.
      b. Johns Manville International, Inc.
      c. Knauf Fiber Glass GmbH.
      d. Owens Corning.
   2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers - 3 lb. density.
      a. Thickness: 1 inch 3 lb. density unless otherwise indicated.
      b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
      c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
      d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
         (1) Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.
         (2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
         (3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
      f. Duct insulation shall contain no urea formaldehyde.

C. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.
   1. Manufacturers:
      a. Armstrong World Industries, Inc.
      b. Or equal
   2. Materials: Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
      a. Thickness: 1 inch unless otherwise indicated.
      b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
      c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
      d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.04 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

E. Ducts that require vibration isolation are specified in Section 23 05 49 Vibration Control. Install specified vibration isolation accordingly.

2.05 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals. Minimum thickness 26 gage.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.06 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with at least 100 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Intervals of lined duct preceding unlined duct.
2. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

J. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.07 ROUND DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

D. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

E. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

F. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
3. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
4. Round Elbows Larger than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

PART 3 - EXECUTION

3.01 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts (before Air Terminal Units): 4-inch wg.
2. Supply Ducts (after Air Terminal Units): 2-inch wg.
3. Supply Ducts (in Mechanical Equipment Rooms): 4-inch wg.
4. Return Ducts (before Air Terminal Units): 4-inch wg.
5. Return Ducts (after Air Terminal Units): 2-inch wg.
6. Return Duct systems w/o terminal units (Negative Pressure): 2-inch.
7. Exhaust Ducts (Negative Pressure): 2-inch wg.

B. All ducts shall be galvanized steel except as follows:

3.02 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to Mason Industries, Inc. "Seismic Restraint Guideline."

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.03 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg, seal transverse joints.

B. Seal ducts before external insulation is applied.

3.04 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Install concrete inserts before placing concrete.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.07 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Backdraft dampers.
   2. Volume dampers.
   3. Motorized control dampers.
   4. Combination fire and smoke dampers.
   5. Turning vanes.
   6. Duct-mounting access doors.
   7. Flexible connectors.
   8. Flexible ducts.
   9. Duct accessory hardware.

B. Related Sections include the following:
   1. Division 26 Section "Fire Alarm" for duct-mounting fire and smoke detectors.
   2. Division 23 Section "HVAC Instrumentation and Controls" for electric damper actuators.
   3. Section 01 74 19 for recycling requirements.
   4. Section 01 81 15 for dust and pollutant control requirements.
   5. Section 01 81 13 for VOC limits, recycled content, regional materials, and other sustainable design requirements.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sustainability Design Coordination:
   1. Contractor shall comply with recycling requirements in Division 01 “Construction Management”.
   2. Contractor shall comply with dust and pollutant control requirements in Division 01 “Construction IAQ”.
   3. Products in this section may also be required to comply with VOC limits, recycled content, regional materials, or other green goals described in Division 01 “Sustainable (LEED) Construction Requirements”.
   4. Provide written notification to the Architect of any non-specified items used in the work of this Section that contain or include:

a. Liquid chemicals, adhesives, sealants, paints, coating, or tapes containing VOC's or other toxins.

b. Composite wood or agrifiber that may contain urea formaldehyde binders.

1.5 SUBMITTALS

A. Sustainable Design Submittals

1. Contractor shall bring the attention of the Architect any items not specified herein that are required for construction and may contain liquid chemicals, coatings, or tapes containing VOC's or other toxins, composite wood or agrifiber that may contain urea formaldehyde binders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.

5. Greenheck.
6. Penn Ventilation Company, Inc.
7. Prefco Products, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.
10. Or equal

B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.

D. Blades: 0.050-inch thick aluminum sheet.

E. Blade Seals: Neoprene.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers:
1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.
10. Or equal

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized steel sheet steel.
3. Or Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
4. Blade Axles: Stainless steel.
5. Bearings: Stainless-steel sleeve.
6. Tie Bars and Brackets: Galvanized steel.

D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.
3. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
4. Blade Axles: Stainless steel.
5. Bearings: Stainless-steel sleeve thrust or ball.
6. Blade Seals: Neoprene.
7. Jamb Seals: Cambered stainless steel.
8. Tie Bars and Brackets: Galvanized steel.

E. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS

A. Manufacturers:
1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.

12. Or equal

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch- thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch-thick, galvanized-steel damper blades with maximum blade width of 8 inches.
   1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
   2. Operating Temperature Range: From minus 40 to plus 200 deg F.
   3. Provide closed-cell neoprene edging parallel seals rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:
   1. Ruskin Company model # FSD 60 or as approved equal.

B. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

C. Fusible Links: Replaceable.

D. Frame and Blades: 0.064-inch-thick, galvanized sheet steel.

E. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

F. Damper Motors: Modulating and two-position action.
   1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
   3. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
   4. Electrical Connection: 120 VAC.

2.7 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
   1. Manufacturers:
      a. Ductmate Industries, Inc.
      b. Duro Dyne Corp.

c. METALAIRE, Inc.
d. Ward Industries, Inc.

2.8 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
   1. Manufacturers:
      a. American Warming and Ventilating.
      b. CESCO Products.
      c. Ductmate Industries, Inc.
      d. Flexmaster U.S.A., Inc.
      e. Greenheck.
      f. McGill AirFlow Corporation.
      g. Nailor Industries Inc.
      h. Ventfabrics, Inc.
      i. Ward Industries, Inc.
      j. Or equal
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Provide number of hinges and locks as follows:
      a. Less Than 12 Inches Square: Secure with two sash locks.
      b. Up to 18 Inches Square: Two hinges and two sash locks.
      c. Up to 24 by 48 Inches: Three hinges and two compression latches.
      d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Corp.
   3. Ventfabrics, Inc.
   4. Ward Industries, Inc.
   5. Or equal

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 6 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.062-inch thick aluminum sheets. Select metal compatible with ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone. Provide stainless steel strip shield over flex connection to protect from weather.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

2.10 FLEXIBLE DUCTS

A. Type
   1. Flexmaster Type 8M– Acoustical Triplelock, or equal.

B. Manufacturers:
   1. Flexmaster U.S.A., Inc.
   2. Hart & Cooley, Inc.
   3. McGill AirFlow Corporation.
   4. Or equal

C. Noninsulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.

D. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.
   1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease. Shall comply with LEED VOC limits in Division 1 “Sustainable (LEED) Construction Requirements”.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

H. Install duct silencers independent of ducts with flexible duct connectors, lagged with loaded vinyl sheet on inlets and outlets rigidly to ducts.

I. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
   1. Upstream side of duct coils.
   2. Downstream from volume dampers, turning vanes, and equipment.
   3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
   4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
   5. On sides of ducts where adequate clearance is available.

J. Install the following sizes for duct-mounting, rectangular access doors:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body Plus Ladder Access: 25 by 17 inches.

K. Install the following sizes for duct-mounting, round access doors:
   1. One-Hand or Inspection Access: 8 inches in diameter.
   2. Two-Hand Access: 10 inches in diameter.

3. Head and Hand Access: 12 inches in diameter.
4. Head and Shoulders Access: 18 inches in diameter.
5. Body Access: 24 inches in diameter.

L. Label access doors according to Division 15 Section "Mechanical Identification."

M. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

N. Connect terminal units to supply ducts directly.

O. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place. Supply ducts only.

P. Connect flexible ducts to metal ducts with liquid adhesive plus tape or approved draw bands.

Q. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 34 00 – CEILING FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. This Section includes ceiling fans for air mixing and ventilation

C. Product Data: For each fixture indicated, include equipment selection with noted location

D. Shop Drawings: Show layout of unit placement, include detailed layout of to coordinate with architecture, lighting, and structure.

E. Maintenance Data: Provide maintenance requirement summary, service schedule outline, and service procedure overview/training for facility engineers.

1.02 COORDINATION

A. Coordinate layout and specific fixture location with architect and structural engineer.

B. Coordinate electrical connections with electrical subcontractor.

PART 2 - PRODUCTS

2.01 Fixture Type

A. Big Ass Fan Haiku (60” and 52”)

B. Manufacturer: Big Ass Fans or equal

C. Type: Direct drive, ceiling, blades.

D. Motor: Motor to be totally enclosed. Motor to be permanently lubricated, variable speed.

E. Disconnect: Provide NEMA 4X (or equal) heavy duty disconnect switch.

PART 3 - EXECUTION

3.01 FIXTURE INSTALLATION

A. The fixture is to be mounted on a plumb, horizontal surface.

B. Verify extension tube length and mounting bracket with manufacturer before ordering.

C. Fans shall be at least 2’ away, in all directions form possible obstructions.

D. Fans shall not be mounted within two times the fan diameter of exhaust or return air intakes, and shall not be in direct line of discharge of HVAC equipment.

E. Fans shall be at least two and one-half times the diameter of the largest fan away from neighboring fans.

3.02 FIELD QUALITY CONTROL

A. Test fixture performance to ensure adequate operation and control

3.03 CLEANING

A. Before installing fans, clean blades, motor, housing, and remote control

END OF SECTION

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Airfoil centrifugal fans.
   2. Backward-inclined centrifugal fans.
   3. Forward-curved centrifugal fans.
   4. Propeller fans.

B. Related Sections Include the following:
   1. Section 01 74 19 for recycling requirements.
   2. Section 01 81 15 for dust and pollutant control requirements.
   3. Section 01 81 13 for VOC limits, recycled content, regional materials, and other sustainable design requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Sustainability Design Coordination:

   1. Contractor shall comply with recycling requirements in Division 01 “Construction Management”.
   2. Contractor shall comply with dust and pollutant control requirements in Division 01 “Construction IAQ”.
   3. Provide written notification to the Architect of any non-specified items used in the work of this Section that contain or include:
      a. Liquid chemicals, adhesives, sealants, paints, coating, or tapes containing VOC’s or other toxins.
      b. Composite wood or agrifiber that may contain urea formaldehyde binders.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

   1. Certified fan performance curves with system operating conditions indicated.

2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

F. Submit sound power levels in accordance with manufacturer requirements.

G. Submit vibration levels in accordance with manufacturer requirements.

H. Submit specified vibration isolation in accordance with manufacturer requirements.

I. Sustainable Design Submittals
1. Contractor shall bring the attention of the Architect any items not specified herein that are required for construction and may contain liquid chemicals, coatings, or tapes containing VOC's or other toxins, composite wood or agrifiber that may contain urea formaldehyde binders.

1.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.3 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 DIRECT DRIVEN BACKWARD INCLINED CENTRIFUGAL INLINE FANS – FANTECH MODEL FR 250

A. General Description:

1. Inline fans shall be of the centrifugal, direct driven type.
2. Fan motors shall be capable of operating in air stream temperatures up to 140 F
3. Motor bearings shall be permanently sealed, self lubricating ball type.
4. 100% speed controllable through a decrease in voltage by using a solid state or transformer type control.

B. Wheel:

1. Fan wheel shall be of the backward inclined centrifugal type with a well designed inlet venturi for maximum performance.
2. Motorized impeller shall be both statically and dynamically balanced as one integral unit to provide for vibration free performance.

C. Motors:

1. Motorized impeller shall be an external rotor type, class B insulation, totally enclosed PSC Type for maximum efficiency.
2. Motor shall be a permanently sealed self lubricating ball bearing type.
3. Motor shall be equipped with automatic reset thermal overload protection.
4. Motor shall be acceptable for continuous duty.

5. Sufficient service factor shall be provided to ensure long maintenance free operation over maximum load conditions.

D. Housing/Cabinet Construction

1. Fan housing shall be constructed of UV resistant ABS-PC blend thermo plastic.
2. Fan shall be supplied with an integral external electrical terminal box with pre-wired terminal strip connections.
3. Capacitor shall be provided and shall be located within the fan electrical terminal box for easy access.

E. Disconnect Switches:

1. NEMA rated: 1
2. Positive electrical shut-off
3. Wired from fan motor to junction box

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Retain and edit three paragraphs and associated subparagraph below for floor-mounting units; delete if vibration and seismic controls are specified in Part 2 "Capacities and Characteristics" paragraphs or are indicated on Drawings. If not scheduled, identify required vibration and seismic-control device by using the titles of devices described in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" and identify its required static deflection.

C. Support floor-mounting units in accordance with manufacturer requirements.

D. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

E. Retain paragraph above for projects not in seismic areas; retain paragraph below for projects in seismic areas.

F. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

G. Retain and edit first paragraph below for suspended units; delete if vibration and seismic controls are specified in Part 2 "Capacities and Characteristics" paragraphs or are indicated on Drawings. If not scheduled, identify required vibration- and seismic-control device by using the titles of devices described in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" and identify its required static deflection.

H. Support suspended units from structure in accordance with manufacturer requirements.

I. Install units with clearances for service and maintenance.

3.2 CONNECTIONS

A. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in duct systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

C. Install ducts adjacent to fans to allow service and maintenance.

D. Retain first paragraph below if fans have scroll drains.

E. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

B. Verify that shipping, blocking, and bracing are removed.

C. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

D. Verify that cleaning and adjusting are complete.

E. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

F. Adjust belt tension.

G. Adjust damper linkages for proper damper operation.

H. Verify lubrication for bearings and other moving parts.

I. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

J. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

K. Remove and replace malfunctioning units and retest as specified above.

L. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 36 00 – SOLAR CHIMNEY FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. This Section includes solar chimney fans for supplemental exhaust

C. Product Data: For each fixture indicated, include equipment selection with noted location

D. Shop Drawings: Show layout of unit placement, include detailed layout of to coordinate with architecture, lighting, and structure.

E. Maintenance Data: Provide maintenance requirement summary, service schedule outline, and service procedure overview/training for facility engineers.

1.02 COORDINATION

A. Coordinate layout and specific fixture location with architect and structural engineer.

B. Coordinate electrical connections with electrical subcontractor.

PART 2 - PRODUCTS

2.01 Fixture Type

A. Model: SC3, 48”

B. Manufacturer: Greenheck, or equal

C. Type: Direct drive, propeller type, Level 3, H-type with straight moderately pitched blades

D. Motor: Motor to be totally enclosed. Motor to be permanently lubricated, variable speed.

E. Disconnect: Provide NEMA 4X (or equal) heavy duty disconnect switch.

F. Free rotation: The fan shall not rotate its blades at vertical airspeed velocities less than 1 meter per second

G. Speed control: Motor to include a variable frequency drive to allow airflow modulation and control

H. Controls – All fans in each chimney shall be controlled by a set of sensors to measure differential static pressure from the chimney inlet and outlet to maintain airflow when natural buoyant based flow does not occur.

PART 3 - EXECUTION

3.01 FIXTURE INSTALLATION

A. The fixtures are to be mounted horizontally on a rigid and horizontal structural support with the airflow directed upward.

3.02 FIELD QUALITY CONTROL

A. Test fixture performance to ensure adequate operation and control

3.03 CLEANING

A. Before installing fans, clean blades, motor, housing, and remote control

END OF SECTION

SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:
   1. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
   2. Division 23 Section "Testing, Adjusting, and Balancing" for noise criteria and for balancing diffusers, registers, and grilles.
   3. Section 01 74 19 for recycling requirements.
   4. Section 01 81 15 for dust and pollutant control requirements.
   5. Section 01 81 13 for VOC limits, recycled content, regional materials, and other sustainable design requirements

1.03 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sustainability Design Coordination:

   1. Contractor shall comply with recycling requirements in Division 01 “Construction Management”.

   2. Contractor shall comply with dust and pollutant control requirements in Division 01 “Construction IAQ”.

   3. Products in this section may also be required to comply with VOC limits, recycled content, regional materials, or other green goals described in Division 01 “Sustainable (LEED) Construction Requirements”.

   4. Provide written notification to the Architect of any non-specified items used in the work of this Section that contain or include:

a. Liquid chemicals, adhesives, sealants, paints, coating, or tapes containing VOC's or other toxins.

b. Composite wood or agrifiber that may contain urea formaldehyde binders.

1.05 SUBMITTALS

A. Product Data: For each model indicated, include the following:
   1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
   2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
   3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
   4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.

D. Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

E. Sustainable Design Submittals

   1. Contractor shall bring the attention of the Architect any items not specified herein that are required for construction and may contain liquid chemicals, coatings, or tapes containing VOC's or other toxins, composite wood or agrifiber that may contain urea formaldehyde binders.

1.06 QUALITY ASSURANCE

A. Products: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN REQUIREMENTS

A. All grout, adhesives, sealants, and touch up paint applied on site shall comply with LEED VOC limits in Division 1 "Sustainable (LEED) Construction Requirements".

2.02 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   1. Price.
   2. Titus.
   3. Anemostat Air Products.
   4. Carnes Co., Inc.
   5. Precision Air Products.
   6. Metal-Aire.
   7. Air Factor.

2.03 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

B. Sound tests shall be conducted in accordance with Section 23 05 93 Testing, Adjusting, & Balancing for HVAC, and results shall meet the noise limits specified on mechanical drawings and specifications.

C. All diffusers and grilles shall be selected at a minimum 7 points below the background noise criteria (NC) for the spaces they serve. See table in Section 23 05 93, 3.24 N.

2.04 DIFFUSERS, REGISTERS AND GRILLES

A. General:
   1. Rate units in accordance with ADC Standards and certify catalogued performance.
   2. Provide units mounted on walls or in gypsum board ceilings with surface frame and sponge rubber seal around edge.
   3. Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces.
   4. Units mounted in T-bar ceilings: Provide panel type designed to fit T-bar framing of lay-in tile ceiling.

B. Finishes:
   1. Steel and aluminum construction: Baked enamel off-white finish.
   2. Stainless steel construction: No finish.

C. Accessories:
   1. Baffles: Provide baffles to direct air away from walls, columns, or other obstructions within diffuser operation.

D. Air Device in Conjunction with Ceiling Type Fire Damper and Combination Fire/Smoke Damper: Provide devices of all steel construction to comply with fire rating, and manufacturer's instructions. Do not provide opposed blade dampers at the diffuser neck.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.04 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 238126 – DX SPLIT AIR CONIDITIONING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For DX split system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.03 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. The DX units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

F. The DX system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO).

G. The system shall be factory tested for safety and function.

1) The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
2) All wiring shall be in accordance with the National Electric Code (NEC).
3) The system will bear the Energy Star label.

4) The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
5) The outdoor unit will be factory charged with R410A.

1.4 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.

1.05 COORDINATION

A. Coordinate layout and installation of DX split system air-conditioning units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1) Filters: One set of filters for each unit.

1.07 WARRANTY

A. The units shall have a manufacturer's warranty for a period of one (1) year from date of installation. The units shall have a limited labor warranty for a period of one (1) year from date of installation. The compressors shall have a warranty of six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced at the discretion of Daikin US Corporation according to Daikin's Terms and Conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 DIRECT EXPANSION MULTI-SPLIT AIR CONDITIONING SYSTEM

A. SYSTEM DESCRIPTION

1. A multi-split type air conditioning system.

2. The system shall consist of multiple evaporators connected to a single condenser unit or multiple condenser units.

3. The condenser shall be a direct expansion (DX), air-cooled, heat pump multi-zone split air-conditioning system, with inverter driven variable speed compressor(s), using R-410A refrigerant.

4. The condensing unit may connect an indoor evaporator capacity up to 130% to that of the condensing unit capacity.

5. All indoor units are each capable of operating separately with individual temperature control.

B. Water Cooled Condensing Units:

1. The 2MXS18NM condensing unit model numbers and the associated number of connectable indoor units per 2MXS18NM condensing unit are indicated in the schedule on the contract drawing. Each indoor unit or group of indoor units shall be independently controlled.

2. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin scroll compressors, motors, brazed plate heat exchanger, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and liquid receivers.

3. Discharge pressure gas line, liquid and suction lines must be individually insulated between the condensing and indoor units.

4. The connection ratio of indoor units to condensing unit shall be permitted up to 130%.

5. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit.

6. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.

7. Each condensing unit shall have a 240VAC, 0.3mA-0.5A control circuit output for water pump or isolation valve operation. This circuit shall be configured at commissioning to operate based on system or compressor operation.

8. Each condensing unit shall incorporate normally open, 15VDC and 1.0mA rated contacts for integration of a mandatory flow proving device.

9. Each condensing unit shall incorporate contacts for electrical demand shedding from a central BMS, utility control or demand meter.

10. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.

11. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heater, fusible plug, overload relay, inverter overload protector, thermal protector for compressor motor, over current protection for the inverter and anti-recycling timer.

12. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.

13. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.

14. Unit Cabinet:

a) The condensing unit shall be corrosion resistant. The unit shall be constructed from rust-proofed, mild steel panels coated with a baked enamel finish.

15. Condenser Heat Exchanger:
    a. The condenser heat exchanger shall be a stainless brazed plate type designed for closed loop/dry cooler applications. Coaxial type heat exchangers shall not be acceptable.
    b. The heat exchanger shall have a maximum system water pressure of 285 psi (equivalent to 640ft of head).

16. Compressor:

    a. The Daikin inverter scroll compressors shall be variable speed (PWM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.

    b. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G-type” with a maximum speed of 6,450 rpm.

    c. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.

    d. The capacity control range shall be as low as 8% to 100%.

    e. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.

    f. Oil separators shall be standard with the equipment together with an intelligent oil management system.

    g. The compressor shall be spring mounted to avoid the transmission of vibration.

    h. Units sized 3-10 ton shall contain 1 compressor

17. Electrical:

    a. The power supply to the outdoor unit shall be 460 volts, 3 phase, 60 hertz +/- 10%.

    b. The control voltage between the indoor and outdoor unit shall be 18VDC non-shielded, stranded 2 conductor cable.

    c. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one 2-cable wire, thus simplifying the wiring operation.

18. Heat Pump Systems:

a) For heat pump systems, operation of the system shall permit either cooling or heating of all indoor units simultaneously.

b) Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BMS interface.

C. Indoor Fan Coil Unit:

1. The Daikin condensing unit shall be interconnected to indoor unit models in accordance with Daikin's engineering data book detailing each available indoor unit.

2. The indoor unit shall be operable with R410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grille. It shall be connected to outdoor unit heat pump. It shall be a four-way air distribution type, ivory white, impact resistant, and washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°.

3. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable.

4. The indoor units sound pressure shall range from 28 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

5. Indoor Unit Construction:

a. The Daikin indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

b. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.

c. Both refrigerant lines shall be insulated from the outdoor unit.

d. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 21" of lift.

e. The indoor units shall be equipped with a return air thermistor.

f. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.

g. The voltage range will be 253 volts maximum and 187 volts minimum.

h. Electrical:
(1) A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
(2) Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
(3) Transmission (control) wiring between the indoor and remote controller shall be a maximum distance of 1,640 feet.

i. Control:

1) The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.

j. Accessories Available:

(1) Fresh air intake and supply air duct connections.

(2) Remote "in-room" sensor kit (KRCS01-1), wall mounted, hard wired remote sensor kit for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit.).

D. REFRIGERANT PIPING

The system shall be capable of refrigerant piping up to 82 actual feet from the condensing unit to the furthest indoor unit, a total combined liquid line length of 164 feet of piping between the condensing and fan coil units with 49 feet maximum vertical difference, without any oil traps.
REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install DX split system air-conditioning units level and plumb, maintaining manufacturer's recommended clearances.

B. Install suspended components level.

C. Install floor-mounting units on bases designed to withstand, without damage to equipment, seismic forces required by code.

D. Support suspended units from structure per structural details with isolation hangers where specified.

E. The DX split system must be installed by a Daikin factory trained contractor/dealer.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Drainage Connections: Comply with applicable requirements in Division 23 Section "Domestic Water Piping."

D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing computer-room air-conditioning units and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that DX split system air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance test, and change filters.

3.05 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain DX split system air-conditioning units. Refer to Division 1.

END OF SECTION

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ducted fan coil units and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of fan coil unit indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fan coil units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals.

1. Include the following for operations and mianteninace:

a. Maintenance schedules and repair part lists for motors, coils, and filters.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Coil Unit Filters: Furnish 2 spare filters for each filter installed.
2. Fan Belts: Furnish 3 spare fan belts for each unit installed.

1.7 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. Warranty Period: 4 years from date of Substantial Completion.
3. Warranty Period (Compressor Only): **5** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTED FAN COIL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation.
2. Daikin Applied
3. Engineered Air Ltd.
4. ENVIRO-TEC.
5. Trane.
6. YORK International Corporation.
7. Or equal

B. Coil Section Insulation: **1/2-inch- (13-mm-)** thick, **coated** glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1.

D. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

E. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
1. Dampers: Aluminum or galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

F. Filters: HEPA

G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.

H. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and brazed joints at fittings. Comply with AHRI 210/240, and leak test to minimum 450 psig (3105 kPa) for a minimum 300-psig (2070-kPa) working pressure. Include thermal expansion valve.

I. Steam Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 75 psig (517 kPa).

J. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

K. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

L. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive fan coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan coil units level and plumb.

B. Install fan coil units to comply with manufacturer requirements.

C. Suspend fan coil units from structure with elastomeric hangers.

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices **48 inches (1220 mm)** above finished floor.

E. Install new filters in each fan coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

B. Connect supply-air and return-air ducts to fan coil units with flexible duct connectors" Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to manufacturer requirements.

D. Connect wiring according to manufacturer requirements.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION

SECTION 260100 - ELECTRICAL INSTALLATION

PART 1 - GENERAL

1.1 COMPLIANCE WITH REGULATIONS

A. The whole of the electrical works shall be carried out in compliance with the Regulations for Electrical Installations 16th Edition (1993) issued by IEE London in as much as they comply with IEC Publication 364, "Electrical Installation of Buildings" and the European Committee Electrotechnical Standardization (CENELEC).

1.2 STANDARDS

A. Except where otherwise indicated in this specification, the Contract Works and all manufactured items shall comply with the relevant specifications of the British Standards Institution. Such specifications are herein referred to as "BS". In each case, the latest editions of such specifications shall apply.

B. Should it be desired to offer equipment covered by other National or International Standards, the approval of the Engineer must be obtained, in writing, before completion of tender documents.

1.3 EQUIPMENT SUBMITTALS

A. Provide submittals for the following equipment:

1. Main Distribution Center, MDC
2. Emergency Distribution Center, EMDC
3. All panelboards
4. Light fixtures
5. Generator
6. Automatic Transfer Switch, ATS
7. Metering equipment
8. Communication Equipment

1.4 RECORDS DRAWINGS

A. The Contractor shall mark accurately on one set of drawings the conduit laid during the progress of the work. This information must be made available on site for inspection by the Engineer.

B. At the completion of the contract, the contractor shall supply the Engineer with one set of transparent originals and two complete sets of prints showing the complete installation. The drawings shall include the location of all apparatus and cable routes and schematic of mains distribution.

1.5 CONTRACT DRAWINGS

A. The drawings forming part of this specification are to be read in conjunction with this specification to enable the Contractor to prepare a tender.

B. These drawings are not intended to be used as working drawings unless they are released for that purpose.

1.6 WORKING DRAWINGS

A. The Contractor shall prepare working drawings as may be necessary. They shall be submitted to the Engineer for approval before the execution of the works.

B. Working drawings to be prepared by the Contractor shall be detailed as below but not restricted only to these:

C. General arrangement drawings showing plant, MV switchboards, distribution boards, consumer units, fittings, switches, switch sockets, etc.

D. Layout drawings of concealed a surface conduit, ducts, trunking, etc.

E. Any other drawings that are not called for in the specification.

F. Two copies of all working drawings shall be submitted to the Engineer for approval. Thereafter, the Contractor shall submit copies of approved working drawings for distribution to all parties concerned.

G. The Contractor shall not be relieved of any of his obligations under the Contract from correcting any errors on site or elsewhere found consequently in the approved working drawings.

1.7 Labels

A. All switchgear, switch fuses, distribution boards, etc. shall be clearly labelled with Black and White background engraved labels to indicate the name, purpose and position of the gear. All circuits in distribution boards shall be clearly identified in respect of the number and location of the MCB. The chart shall be securely fixed inside the cover of the distribution.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. All switchgear, distribution boards, motor control centers, and other panels shall comprise factory built assemblies of the multi-cubicle type.

B. Panels shall be free standing, of uniform height, flush mounted and totally enclosed to not less than IP 42 in accordance with BS 5420:1977 (IEC 144:1963). When size of starters and other components does not justify this type of Construction, wall mounted patterns may be used.

C. The base of the panel shall be effectively sealed against the ingress of vermin and termites, and all equipment shall be rated for continuous operation in a tropical climate.

D. Any ventilation louvers shall be backed by brass mesh gauze to exclude termites.

E. Framework for the panels shall be of welded construction, and panels shall be fabricated from mild steel sheet of 2mm minimum thickness, folded and braced where necessary to provide a rigid structure.

F. All bolts, nuts, screws hinges, handles etc. shall be corrosion resistant.

G. Interiors shall be finished white, and the exterior shall be finished to a light grey shade, and the plinth shall be black.

H. Cabling access shall be from the rear by means of gasketted bolt-on plates, which shall be fitted with handles to facilitate removal/replacement.

I. Access to the cubicles or cubicle compartments for all normal routine maintenance shall be from the front with hinged and lockable doors fitted with neoprene gaskets (all gaskets shall be termite resistant) and chromium plated lockable tee type handles. All doors shall be electrically bonded to the main frame, using adequate flexible conductors, protected against mechanical damage. All locks on a given panel unit shall be operated by the same key.

J. Each multi-compartment control panel shall comprise an assembly of individually constructed cubicles. These shall be assembled to include a metallic sheet between adjacent cubicles.

K. In each multi-compartment panel at least one empty compartment shall be provided for future use.

L. In single unit panels, enough space shall be available for the addition of at least 10% more components for future use.

M. Panels shall be readily capable of extension at either end, within the bus-bar rating.

N. Where panel size is excessive, easily handled sections shall be supplied for site assembly. Sections shall be fitted with eyebolts, which after positioning of the panels, shall be removed and replaced with plated bolts and washers.

O. Bases shall be of rigid construction capable of withstanding stresses during replacement, such as those imposed by moving the sections on rollers.

P. These shall be self-supporting, floor mounted, totally enclosed, dust-proof, air-insulated, cubicle type of uniform height, flush fronted switchboards, complying with B.S. 5486. (IEC 439:1973).

Q. All equipment shall be suitable for use on a 400 volt, 3 phase, 50 Hertz, 4 wire supply with neutral and ground busses and shall be so constructed as to be capable of withstanding the thermal and dynamic stresses produced by a short circuit, should this occur within any part of the panel.

R. Front doors shall be fitted with neoprene gaskets. (All gaskets shall be termite resistant).

2.2 BUS-BARS

A. All bus-bars shall be of electro tinned HDHC copper, and shall be of uniform section throughout the length of the panel.

B. They shall be run in a separate screened compartment, divided with barriers into as many compartments as there are cubicles in the panel.

C. Access to individual compartments shall be via bolt-on cover plates, each bearing the legend in white on a red background:

2.3 "DANGER - LIVE BUS-BARS", also the Read Arrow symbol denoting danger from electric shock.

A. The neutral bus-bar shall be not less than the cross-sectional area of the phase bars. Phase bars shall be color coded Red, Yellow and Blue: the neutral shall be black.

2.4 RISING MAINS

A. All busbar trunking shall be of approved manufacture, current ratings as detailed on the drawings/schedules and complying to degree of protection IP42, as defined in BS5420 (IEC144).

B. The busbar shall be designed and manufactured to comply with BS5486 part 2 (IEC 439-2). For use on a 400 volt 3 phase 4 wire 50Hz supply, and capable of withstanding prospective fault level currents as detailed on the drawings/schedules.

C. The enclosure shall be manufactured from shaped extruded aluminium back channel with conductors completely sleeved in non hygroscopic non tracking Noryl insulation. The interlocking front cover will also be manufactured from Noryl. Tapping outlet positions will be provided at 2 per metre spacing.

D. The conductor bars shall be channel shaped hard drawn high conductivity copper or aluminium (E91E) as specified in the drawing/schedules. Full size neutrals will be provided in all busbar trunking and associated fittings.

E. When change of direction, rating or termination occurs in a busbar run, manufacturers purpose made fittings shall be used.

F. Each tapping outlet position shall be provided with an automatic shutter to screen entry to live busbars when the position is not occupied by a tapping box.

G. Fire resisting barriers shall be provided where the enclosure passes through a fire rated floor or wall positions; the fire barriers shall be manufactured from an approved fire resisting material, and should be suitable for site fitting.

H. Expansion fittings manufactured with copper braid conductor shall be fitted in accordance with the busbar manufacturer's recommendations.

I. Tapping boxes shall be "plug in" type fitted with HRC fuses, MCBs, MCCBs switch-fuses or socket outlets as detailed in the drawings/specification.

J. The enclosure shall be constructed from galvanized sheet steel and fitted with a safety device to ensure non-reversibility when connected to the busbar. Earthing should be provided by dual Earthing contacts independent of the fixing clips.

K. Tapping boxes shall be designed and manufactured so that current carrying metal is not exposed during insertion or removal, and the unit is connected to earth before contact is made with live busbars. The unit shall remain earthed during removal until all live connections are disconnected.

L. The busbar trunking system shall be as manufactured by Barduct Ltd or equal and approved.

2.5 DISTRIBUTION BOARDS

A. Type and Rating

1. General lighting and power distribution boards shall comply with BS 3817, BS 5861 and BS 214 and shall be of the metal clad pattern, flush mounted except where otherwise specified on the drawings.

B. Construction

1. Enclosures shall be substantially constructed from 16SWG minimum thickness sheet steel having hinged front cover and shall be vermin and insect proof. Each unit shall house MCBs and shall be supplied complete with bus-bars, earthing terminal, neutral bar, circuit chart and blanking plate for spare ways. The incoming isolator switch shall be integral with the distribution board in consumer's units only, or as may specifically be requested for.

C. Mounting

1. All distribution board and consumer units shall, unless detailed to the contrary, be mounted with the lower edge 1950mm from the finished floor level.

2. Isolators, switchfuses, (other than those mounted on bus-bar chambers or providing local control), cookers control units, water heater controls, etc, shall unless otherwise stated on the drawings, be mounted at 1350 mm from the finished floor level to the underside of the fittings.

D. Miniature Circuit Breakers

1. All distribution boards shall be supplied with MCBs manufactured to BS 3871 and of a rating as specified on the drawings. The circuit breakers shall incorporate both terminal overload and magnetic short circuit tripping, with a trip-free mechanism.

2. Three phase circuits shall be controlled by integrally manufactured three pole breakers, with one common operating lever. An inter-tripping mechanism shall ensure isolation of all three poles in the event of an overload or short circuit on any one phase.

2.6 METALLIC COUNDIT

A. Metallic conduit shall be of heavy gauge solid drawn or welded steel to British Standard Specification 31, Class B. No conduit shall be less than 20 mm diameter. Conduits installed within buildings shall be black enamel finish. Where installed externally or on surface in basement areas, conduits shall be galvanised.

B. Conduit fittings shall be the same metal as the conduit to which they are connected except that Zinc - alloy OR aluminium - alloy fittings may be used with steel conduit.

C. Conduit fittings and accessories shall confirm to the appropriate B.S.S. Conduit runs shall be mechanically and electrically continuous.

D. All bends and sets shall be made cold without altering the section of the conduit. The inner radius of the bend shall not be less than 2½ times the outside diameter of the conduit. Not more than two right bends will be permitted without the inter-position of a draw-in box. Where straight runs of conduit are installed draw-in boxes shall be provided at distances not exceeding 12 metres. Tees, elbows or sleeves of either inspections or solid type will not be permitted.

E. Conduits which terminate the fuse gear, distribution boards, adaptable boxes, non-spout switches, trunking, etc. shall be connected thereto by means of screwed sockets and smooth bore brass male-bushes. Where conduits are installed flush in floor slabs or in chases in walls, they shall be held firmly in position by means of substantial pipe hooks driven into wooden plugs. Where conduits are installed on surface, they shall be fixed with spacebar saddles at a distance not exceeding 900 mm. Conduits shall be installed entirely separate and at least 150 mm clear of the hot water and steam pipes and at least 75 mm clear of cold water and other services.

F. The Electrical Contractor shall be responsible to ascertain from site, details of reinforced concrete and structural steel works and to check from the Main Contractor's drawings the positions of walls, structural concrete and steelwork finishes etc. No reinforced concrete or steel work shall be drilled without obtaining permission from the Structural Engineers.

G. All the circular conduit boxes shall be of malleable iron conforming to B.S. 31 with two inches fixing centres fitted with H.G. lids where required. They shall be long spouts internally threaded. Deep boxes or extension rings on standard circular boxes shall be used where necessary in order to bring the front face of each box flush with the ceiling or wall.

H. Conduit boxes installed externally shall be galvanised and where subjected to direct weather conditions they shall be compound filled.

2.7 NON-METALLIC

CONDUIT A. Standard and

Installation

1. All non-metallic conduit shall be class "A" heavy gauge, high impact PVC complying with BS 4606 part 2, type AH.

2. The minimum size to be on the contract is 20 mm external diameter. All conduit installations shall be concealed in the walls and floors or in structural slabs.

3. Conduits shall be kept at least six inches clear of gas piping and color coded orange when required. Conduits shall be kept at least six inches clear of steam and hot water systems and preferably beneath the aforementioned services.

4. Conduits runs shall be complete before wiring is begun and shall not be dismantled for wiring operations. Conduit used in flameproof installations shall be of the solid drawn type.

B. Bends

1. Bends and sets in the conduit will be made in accordance with the manufacturer's instructions. The radius of the bend shall not be less 2.5 times the outside diameter of the conduit, or such greater radius which will facilities easy drawing in of cables.

2. All conduit bends are to be made on size and not more than two right angle bends will be permitted without the interposition of a draw box.

C. Expansion

1. Adequate allowance shall be made for longitudinal expansion and contraction of the conduit under normal working temperature variations as follows:
2. Expansion couplers should be used in straight runs exceeding 6 meters with a loose or flexible type joint at the long spout end of the coupler.

3. Saddles as supplied by the manufacturers shall be include a sliding support tolerance for longitudinal expansion.

4. Saddles shall be installed within 300mm either side of conduit boxes where the free length of conduit exceeds this distance.

5. Multiple saddles shall be used where two or more surface conduits run parallel and adjacent to each other.

6. Special consideration may need to be given to the fixing of accessories where this may prevent natural conduit movements. Oversize or slotted fixing holes may be necessary or introduction of expansion couplers.

D. Conduit Boxes and Fittings

1. All conduit boxes shall be circular or square pattern of rigid PVC suitable for plan connections conforming to sheet 62 BS 4606, Part 2. Boxes supporting a fitting or accessory shall be fitted with a PVC lid held in position by means of two 2BA round headed screws. Boxes shall have metallic screwed inserts.

2. Circular or square boxes shall be provided at all outlet points, unless otherwise specified; lighting fittings, ceiling fittings, ceiling switches and other accessories will be screwed to the internal lugs of the boxes.

3. Care must always be taken when considering the use of totally enclosed fittings with PVC circular boxes where the temperature within the box is likely to rise above 60 deg. C (140 deg.F). In this case, special steel insert clips should be used in conjunction with circular boxes where this problem can arise and also in situations where heavy pendants are used.

4. Looping boxes of circular PVC pattern to sheet 63 BS 4607 Part 2 may be used in such work as dictated by the structure of the buildings. Conduit entry shall be made by means of PVC bushes.

5. Adaptable boxes shall be of molded or fabricated PVC of square or oblong shape complete with PVC lids secured by 2BA brass or steel plated round-headed screws. All adaptable boxes and lids of the same size than 75mm x 50 mm or larger than 300mm x 300mm shall be employed. Boxes shall be adequate depth in relation to the size of conduit entering them.

6. Conduits shall be terminated at adaptable boxes; fuseboards, switches, sockets or other equipment or possessing push-in or threaded spouts, by means of appropriate size female adapter and PVC hexagonal headed male bush. All cemented joints to be made to a depth of not less than the diameter of the conduit being used.

E. Earth Continuity

1. Earth continuity shall be provided by a separate insulated conductor drawn into the plastic conduit and rated in accordance with circuit loadings and appropriate Regulations or as mentioned on the drawings.

2. Where required under the regulations, and earth continuity conductor shall be provided for lighting fittings in which case the control switches shall be equipped with an appropriate earth terminal.

F. Arrangement of Conduit Layout

1. The conduit system shall be carefully planned and erected to avoid all unnecessary bends or changes in direction. Conduits shall be laid in straight horizontal or vertical lines with easy sets. Where several conduits follow similar routes, they shall be neatly grouped in multiple runs. Where multiple runs change directions, the radii of the sets shall be laid out from a common center. Where draw-in boxes for right angled change of direction are required in multiple runs, adaptable boxes shall be used for such sizes as to allow all conduits to enter the box with ease.

2. Where conduits are concealed or laid on structural floors, they shall be secured by a fixed method to be approved by the Engineer. Where it is essential that conduits cross one another in floors, the chases shall be deepened and the conduits set to create the minimum desirable diversion.

3. Care shall be taken to ensure that there is no obstruction to cables within the conduits caused by the ingress of plaster, concrete or other matter. Conduit ends must be cut square and cleaned of burrs.

2.8 FINAL SUB-CIRCUIT

WIRING A. Type

1. All power and lighting wiring cables shall be 600/1000V grade, single core PVC insulated, with stranded copper conductors manufactured in accordance with BS 6004. The minimum sizes of lighting circuits shall be 1.5mm sq; and ring main circuits 2.5mm sq.

B. Installation

1. No reduction of the strands forming the conductors hall be allowed at switch or other terminal, but all strands shall be effectively secured with screws, nuts and washes or other approved means.

2. Cables shall be joined together at the terminals of ceiling boxes and other accessories. Under no circumstances will joints be permitted in the run of the cable.

2.9

CABLES

A. General

1. The wiring throughout shall be looping cables from point to point and to tee-off other joints will be permitted. Conductors of the same circuit shall be contained in the same conduit or trunking. At distributions boards, the neutral conductors shall be connected to the neutral bar in the same sequence as the line conductors connected to the fuses or circuit breakers so that they can be readily identified.

B. P.V.C. Cables in Conduits

1. PVC cables in conduit unless otherwise specified shall conform to B.S. 6004:1969, Table 5, 600/1000 volts grade single core PVC insulated. No cable smaller than 1.5 mm² shall be used in the installation.

C. Flexible Cords

1. Flexible cords shall be of 300 volts grade, V.R.I. or PVC insulated conforming to B.S. 6500:1969. No flexible cord shall be smaller than 0.72 mm².

D. P.V.C. Armoured Cables (with copper conductors)

1. These cables shall be 600/1000 volt grade, conforming to B.S. 6346:1969, having stranded copper conductors with PVC insulation, cores laid up circular, PVC sheath beading, single wire armour and PVC sheath.

2. These cables shall be terminated on distribution boards, switchboards, trunking or adaptable box with compression type brass gland with locknuts and shroud.

E. P.V.C. Armoured Cables (with copper conductors)

1. These cables shall be 600/1000 volt grade, conforming to B.S. 6346:1969, having stranded copper conductors with PVC insulation, cores laid up circular, PVC sheath beading, single wire armour and PVC sheath. These cables shall be terminated on distribution boards, switchboards, trunking or adaptable box with compression type brass gland with locknuts and shroud.

F. P.V.C. Armoured Cables (with Aluminium Conductors)

1. These cables shall be 600/1000 volts grade, conforming to B.S. having cores of solid Aluminium conductors insulated with PVC, armoured with aluminium strip or steelwire with PVC sheath overall.

G. Laying of Cables

1. The work of excavating and back-filling of all trenches is included in this contract and the responsibility for positioning, width and depth of trenches, laying and bedding of all cables and protective covers is included with the Electrical Works covered by this specification.

2. Where more than one cable is laid in a trench, cables shall be spaced as follows:

a.	Between MV cables	100 mm
b.	Between MV and telephone cables	400 mm
c.	Between MV and LV cables	400 mm
d.	Between LV and telephone cables	400 mm
e.	Between LV cables	100 mm

3. In straight run trenches, cable crossing shall not be permitted except where cables branch from the main run.

4. At every draw-in point, the bottom of the trench shall be evenly graded and cleared of all loose stones and shall then be covered with an 80 mm layer of sand or sifted soil and lightly compacted. A further 80mm layer shall be placed on top of the cables.

5. The approved cable protection shall then be laid and the trench refilled with excavated materials in 200mm layers, each layer being well compacted by hand or mechanical pinners before the next layer is filled.

6. The width of the trench shall be such that a clearance of 80 mm shall be provided between the outermost cable and the side of the trench.

7. Where cables are disposed in more than one layer, the vertical spacing shall be 400mm between centers of cables or cable groups the depth of the trench being made suitable accordingly.

8. Stones or other hard objects shall not be included in any of the backfilling materials.

9. In the laying of PVC mounted cables, the internal radius of bends shall be six times the overall cable diameter.

H. Projective Covers

1. The protective covers, manufactured in accordance with BS 2484 shall be provided over cables laid in the ground, each complete with an interlocking device to prevent lateral displacement.

I. Cable Position Markers

1. These should be placed adjacent to all points where cables change direction and all intervals of not more than 30 meters and at other positions designated by the Engineer.

J. Sealing of Cable Entries

1. Where cables enter buildings, pipes, or ducts, the mouths of the pipes or ducts shall be effectively sealed by means of close fitting solignum impregnated wooden plugs and a mixture of compound and transformer oil; or other approved manner.

K. Protection Against Mechanical Damages

1. All cables located in such positions where they are vulnerable to damage by mechanical or other means shall be protected by suitable lengths of steel pipe bushed to prevent damage to the cable.

L. Rating Plates

1. Each cable when completely erected shall have permanently attached to it at each end in such intermediate positions as may be considered necessary by the Engineer, metal plates upon which is engraved, or stamped, the identification number of cable together with the voltage, size and make-up, and the service which it supplies.

2. This information shall be recorded by the contractor so that it may appear on drawings of the completed installation.

M. Cable Sealing and Termination

1. The Contractor shall be wholly responsible for the sealing and jointing of all cables supplied and erected under the contract.

2. The cable boxes, looping-boxes and glands for LV cables on all items of equipment shall be provided under the contract.

3. Sealing and jointing shall be in accordance with the best current practice and of high quality class workmanship. Where cable armoring is used as earth continuity conductor, the glands shall have the necessary contact surface or provide a low resistance parth under fault conditions.

4. The tender shall include for all cable jointing where appropriate and all labour, joining material and compound, together with the use of all jointers' tools and making off the cable tails to the apparatus terminals.

N. Cable Details

1. The contractor shall submit a schedule of all cables, detailing the following for each cable proposed:-

a. Reference Number
b. Type
c. Cross Section Area
d. Number of Cores
e. Origin
f. Destination
g. Cost per metre installed
h. Cost for each termination (gladding and Making off)
i. Route Length
j. Operating Voltage
k. Estimated Current
l. Percentage Volt Drop

2. Rates (g) and (h) shall be used to assess costs in the event of any agreed route length variation.

3. The contract price shall include all cables required for a fully operational installation.

2.10 SOCKET OUTLETS

A. General

1. *In all areas, general power outlets shall be of the 16A, 250 V, twin gang, 3 pin universal fused plug type complying with British Standards.* They shall be flush pattern, with white or ivory cover plates unless otherwise specified on the drawings. Where the circuits are supplied from a common feed, two outlets shall form a twin unit in a common box. The earthing terminal of every socket outlet shall be connected to the earth continuity conductor of the final sub-circuit by an appropriately sized insulated copper conductor. Unless otherwise stated all socket outlets shall be mounted at 300mm above the finished floor level.

B. Telephone and Computer Outlets

1. These shall be of the type as specified in the Bills of Quantities, or in the particular specification for telephone work. Unless otherwise specified they shall be mounted at 300mm above the finished floor level.

2.11 FUSED CONNECTION UNITS

A. Connection Type

1. All fused connection units shall be of the 13A type with fuse and neon indicator lamp. Boxes shall flush type with white or ivory plates and shall be switched type unless otherwise specified on the drawing.

B. Fuses

1. All fused connection units shall be fitted with 13A fuses, unless otherwise specified.

C. Labeling

1. The front plates of each fused connection unit shall, unless otherwise specified, be engraved with the name of the appliance connected to it.

2.12 LIGHTING SWITCHES

A. Type

1. Lighting switches shall be of the all-insulated rocker-operating plate-switch type to BS 3676, and shall be of ample rating. Switch inserts shall be white with ivory cover plates.

2. All flush or surface installed switches shall, unless otherwise specified, be mounted at a distance of 1400mm above finished floor level.

3. Ceiling switches shall be positioned at not less than 300mm from the point which they control.

4. Switches shall be one-way, two-way, or intermediate and where a number of switches are mounted together, they shall be fitted in a common box. All lighting switches shall be connected only in the phase line of all circuits.

2.13 LAMP HOLDERS

A. Lampholders shall be of plastic construction with porcelain interiors and bayonet fitting.

B. Lampholders for lamps rated 200W and above shall be of the Edison Screw type. Battern type Lampholders shall be of the all-insulated bayonet.

2.14 LIGHTING FITTINGS

A. Lighting Fittings

1. The Contractor shall supply and fit all lighting fittings of the type indicated on the drawings and in the Schedule/Bills of Quantities, and he shall determine the exact positions of fittings as indicated on the drawings, agreeing where necessary with the Engineer.

2. All fittings shall be suitable for operation on a 220V, 50Hz supply and where necessary shall be supplied complete with control gear.

2.15 LIGHTING COLUMNS

A. Type

1. Columns shall be made of galvainzed sheet steel. Doors giving access to the mounting plate for cut-outs and control gear shall be weatherproof and provided with a locking device.

2. The column shall be electrically continuous and shall be provided with an easily accessible corrosion resistant earth terminal having substantial contact surfaces for attachment of an Earthing lead.

B. Spacing and Siting

1. Street lighting columns shall be erected in positions as per design requirements. Slight variations in siting to all for plot entrances and private driveways may be permitted but these shall be subject to prior approval by the Engineer.

2. Columns shall be sited at least 1200mm from the edges of curbs as to minimise the chance of collision damage from road vehicles, and the impediment of movement of pedestrians on the footways.

C. Column Erection

1. Columns shall be planted vertically in the ground to the specified depth, so as to give the required mounting height. Bracket arms shall be placed at right angles to the road axis.

2. The bottom end of the column shall be surrounded in concrete and the soil around columns shall be well compacted and leveled off. Any soil left over shall be cleared away from the site.

3. Columns shall be positioned at a uniform distance from the kerbs as per drawing, and on a straight road, the columns shall appear to be in a straight line when viewed from one end.

D. Supply Cables

1. Supply to the lighting columns shall be by means of 600/1000V PVC insulated, armoured, stranded copper conductor cables (PVC-SWA-PVC) to BS 6346 and under footways to a depth of 500mm. Cables shall be taken into lighting columns through services entries below ground and terminated on the backboard of the column. Where necessary, cables shall be laid in ducts.

E. Road Crossing

1. Cables crossing carriageways and plot entrances shall be laid in the ducts at a depth of 750mm. The crossings shall be as short as possible and the ducts shall extend 450mm beyond the carriageways. The internal diameter of ducts shall be 100mm or more as specifically stated in the Schedule /Bills of Quantities.

2.16 SWITCHING CONTROL

A. The security lights shall be switched and controlled by a Programmable Time Switch, or a specified photo-sensitive switch.

B. Control Pillars

1. Control pillars shall be weather-proof and dust-proof and made of sheet steel to BS 4360.

2. The pillars shall be erected in positions as per design requirements, mounted on a concrete plinth with the base of the pillar 250mm above ground.

3. They shall be provided with doors constructed so that they cannot be opened except by use of a special key.

4. Mains from the poorer supply utility shall be brought underground into the pillar which shall be provided with a blackplate for mounting a service cut-out, an energy meter and electromagnetic contractor.

5. All wiring shall be neatly routed and loomed. A flange plate shall be provided. The plate which shall be suitably drilled for accepting compression glands for armoured cables terminating inside the pillar, and an easily accessible corrosion resistant terminal of ample proportion shall be provided for earthing.

6. The pillar shall be painted with red oxide primer and finished off in a light grey coloured paint. The word "DANGER" and "HATARI" in red letters of at least 50mm high shall be painted on the door and the lighting flash symbol for electricity shall appear above the words, also painted in red.

C. Contactors

1. Contactors shall be of the electromagnetic air-break type, and shall be tested to BS 5424, PART 1: 1977. These shall be suitable for uninterrupted duty (Class UR)on 220V AC, single-phase, 50Hz supply. Utilization category shall be AC-1 current rating shall be not less than that indicated on the circuit diagrams provided with this specification.

D. HRC Fuses

1. All HRC fuses links shall be type-tested and ASTA certified in accordance with BS 88 Part 1:1975, with Class Q1 fusing factor.

E. Earthing of Lighting Columns

1. The lighting column, bracket and lantern shall be electrically continuous and earth continuity between control pillars and lighting columns shall be maintained via the steel wire armour of underground cables which shall be electrically bonded to the metal work of the columns and pillars by means of compress glands at cable terminations.

2. Lighting columns and control pillars shall each have easily accessible, amply proportioned and corrosion resistant earthing terminals.

3. In addition to the electrical continuity of column and lantern, a copper earth wire shall be connected between earth terminals of the lantern and columns, the earth-wire forming part of 1.5/2.5mm sq. twin-core and earth PVC.PVC cable run from the cut-out to the lantern.

4. The control pillars and very fourth lighting column shall be efficiently and solidly earthed using earth-rods driven vertically into the ground as near to the earthing terminals as practicable.

5. Earth rods shall be of the extensible type, made of 15mm diameter steel-cored copper provided with a steel point at the lower end and a steel driving cap and heavy duty earthing clamp at the upper end.

6. The number of rods to be used at each earthing position shall depend upon the site earthing resistance obtained, which shall not exceed 0.5 ohms. Earth leads shall be insulated, 2.5 mm sq. minimum and protected against mechanical damage where necessary. The leads shall be solidly connected to the earth clamps and the connection painted over with bitumen.

7. The connections shall be accessible, and at control pillars, earthing positions shall be enclosed in concrete chambers (300 mm x 300mm x 300mm) with removable concrete slab covers at ground level.

8. Permanent labels with indelible wording "SAFETY ELECTRICAL EARTH - DO NOT REMOVE" in 4.75mm lettering shall be secured to the leads near the connections.

9. For wooden poles of the electricity utility, earth continuity shall be provided by means of a conductor or suitable size, running from the earth terminal of the lantern/weatherproof adaptable box containing the control gear to the ground. This shall be done at every wooden pole.

F. General Installation Earthing

1. Earth electrodes shall be minimum 1400mm long by 12mm diameter hard drawn copper rod, and shall be located at a convenient position as close as possible to the building. The terminal head of each electrode shall be in a concrete inspection pit, with cover. If the resistance to earth is not satisfactory with one electrode, then additional electrodes or an earth mat shall be provided as directed by the Engineer.

2. Particular attention should be given to conduit and trunking installations to ensure that the earth continuity is reliable and permanent.

3. All apparatus or parts thereof not solidly connected to the earthing system shall be connected thereto in an approved manner by solid copper conductors secured by means of substantial bonding clamps.

4. All services entering the installation at earth potential shall be efficiently bonded to the main earth point.

5. All joints in the earth system shall be made with solderless connectors, or by an approved brazing method.

6. The resistance of the earth continuity system when measured between the main earth point and any other point in the installation, including all metalwork which may provide a path to earth, such as gas, water pipes, etc, shall not exceed 0.5 ohms.

7. All flexible metallic tubing shall have a bare earth conductor run with the tubing, the ends being securely bonded. The size of the earth conductor shall be as indicated in the current edition of the IEE Regulations.

8. Care should be taken in order to ensure that the neutral conductor does not become accidentally earthed.

9. In accordance with the Electricity utility's is procedure of multiple neutral earthing, the neutral of the supply is to be bonded to the earth pipe. The mechanics of bonding will be performed by an official of the utility company.

10. Earthing shall conform to the 16th edition of the IEE Regulations.

G. Distribution System Earthing

1. All distribution boards shall be earthed in accordance with the IEE Regulations. All metalwork associated with the installation shall be earthed to comply with the Regulations currently in force.

H. Testing of Earthing System

1. The resistance o the earth continuity system, when measured between the main earthing point and any other point in the installation, including all conduit and other metal work which may provide a path to earth, shall not exceed 0.5 ohms where steel conduit forms part or whole of the system, 1.0 ohms if the earth continuity system is composed entirely of copper, copper alloy aluminum.

I. Testing of the Installation

1. After completion and before commissioning, the entire installation shall be subjected to the following tests and any faults found shall be rectified.

J. Polarity

1. All fuses and control devices shall be connected in live conductors only.

K. Insulation Resistance

1. When tested with a 500V dc supply, the insulation resistance between conductors of live lines, lines and neutral, line and earth, neutral and earth shall not be less than 1 mega-ohm.

L. Earth Continuity Resistance

1. Resistance of earth continuity measured from a control pillar to the farthest end of a circuit shall not exceed 0.5 ohms.

2.17 LIGHTNING PROTECTION

A. The lightning protection system is made up of three main components: Air terminals, conductors, and ground terminations. Air terminals are the top most elements of the lightning protection system and are designed to intercept a direct lightning strike. Each air terminal is connected together through a closed system of continuous conductors. These conductors lead sown to ground terminations which are critical to assure dissipation of a lightning discharge without damage. These components are specified in greater detail below:

B. Air terminals – Air terminals shall be copper rods a minimum of 13mm in diameter and between 275mm and 600mm tall. Terminals shall be placed on ridges of gables or in line with the exterior wall on the high side on mono-sloped roofs. Terminals shall be spaced at an interval not exceeding 6m along roof ridge and not more than 600mm from each end of ridge end.

C. Conductors – 13mm stranded copper cable conductors shall interconnect and provide a two-way path between all air terminals and to ground terminations. Conductors shall maintain a horizontal and/or downward path to the ground and shall be free of excessive splices and sharp bends. No bend shall form an angle of more than 90 degrees or have a radius of less than 200mm. Fasteners shall be placed on each run of exposed conduit at intervals not exceeding 1m. No less than two down connectors with a proper ground termination at each shall be provided down conductors, which are continuations of roof conductors, shall be as widely separated as possible at opposite diagonal corners of the structure.

D. Ground terminations – Each downlead shall terminate at a ground connection below finished grade. Ground terminations shall consist of 13mm diameter, 2.5m minimum long copper clad steel grounding rods. The down conductor shall be connected to the ground rod using a bronze ground clamp having at least 75mm of contact between the rod and the conductor. The rods shall be located a minimum of 300mm below grade and a minimum of 600mm from the foundation and extend a minimum of 2.5m vertically into the earth.

E. Lightning protection installation shall, in general, consist of copper or aluminum tapes of 20 mm x 3 mm section with similar clips, test clamps and copperbond earth rods which shall be mounted in positions as indicated on the drawings.

F. Earth roof tape shall be provided with a similar copper or aluminum down tape to the earth test position and from the earth test position to the earth electrode.

G. The earth resistance of the completed system shall in no circumstance exceed 10 ohms. If this value cannot be obtained by means of a single earth electrode, extra roads may be used in parallel.

H. The following tests shall be carried out:

1. Verification of polarity (d.c. and single-phase circuits).

2. Phase rotation
3. Resistance to earth of earthing system.
4. Insulation resistance. (Phase/phase and phase/earth)
5. Earth loop impedance.
6. Operation of over-current and earth fault relays by injection test.
7. Operation of all other protective relays and devices.
8. Levels of illumination.
9. Correct sequencing of all control equipment.

I. The Engineer shall be given full opportunity to witness all tests and shall approve all test results.

J. The Engineer shall have the right to ask for specific tests to be repeated.

2.18 COMMISSIONING

A. The whole installation shall be tested to the statutory requirements of the Electricity utility, IEE Wiring Regulations and commissioned in the presence of and to the satisfaction of the Engineer.

B. Four copies of test reports shall be provided within seven days of carrying out the test; and the reports shall include full details of how each test was carried out and a copy of all readings taken.

2.19 SERVICING OF SWITCHGEAR AND TRANSFORMERS

A. The servicing of all high and low voltage switchgear and transformers must conform to the relevant specification and the code of practice of the Electricity utility.

2.20 OVER AND UNDER-VOLTAGE, PHASE FAILURE AND PHASE SEQUENCE PROTECTION

A. The main incoming 400 volt switchboards and control panels shall be equipped with a relay which detects un-acceptably high or low voltage.

B. It will monitor all phases and will cause all incoming circuit breaker(s) to trip when the voltage exceeds a maximum or minimum (which shall be selected from a range of settings). Visual indication shall be given of the cause of tripping and an electrical hours counter will record the time which during the supply exceeds the set limits.

C. Resetting of the relay shall be automatic but re-closure of the tripped circuit breaker shall be manual.

D. It shall be possible to delay the operation of the relay in order to ride through transient voltage variations.

E. Phase failure shall cause the circuit breaker to trip immediately and incorrect phase sequence will prevent the circuit breaker from being closed.

F. The Lavato Electronic Voltmeter Relay type RVT manufactured by the Officine Electromeccanica Lavato of Italy meets the requirements for this application. Alternatives may be offered for the approval of the Engineer.

2.21 SURGE VOLTAGE PROTECTION

A. In order to give protection against transient over-voltages or voltage surges such as result from lightning strike, surge arresters shall be installed on the 400 volt bus-bar of the main LV panel.

B. They shall be connected permanently between each phase and earth and shall be suitable for continuous operation at 400 volts, and shall comply with the class 2.5KA requirements according to IEC 99.

2.22 TERMINALS

A. Terminal board insulation shall be polyamide or equivalent. Melamine types are not acceptable.

B. All connectors shall be of brass or bronze, with screw of similar materials. Contact between dissimilar metals is not acceptable. No steel screws, plated or otherwise shall be used. All terminal screws shall be captive.

C. Terminals shall be mounted at least 250mm above their associated gland plates.

D. Only one conductor shall be connected to each terminal. Multiple connections shall be effected using links.

E. Main power terminals shall be stud and nut types, with plain and locking washers. Conductors terminating on these shall be fitted with insulated crimped lugs. Rail mounted terminals for cables in excess of 32 mm sq. cross-sectional area are not acceptable.

2.23 GLAND PLATES

A. Adequately sized blank gland plates shall be provided below each outgoing terminal section to accommodate the requisite glands.

B. Gland plates shall be positioned 200 mm minimum above the base of the cubicle, and shall be solidly bonded to earth.

C. Suitable sized compression type cable glands shall be provided for all cables. Glands used for armoured cables shall include provision for sealing the armour wires to protect them from corrosion and to prevent ingress of moisture into the cable.

D. Brass lugs shall be provided for connection of the cable armouring to earth.

2.24 FAULT LEVELS

A. The following prospective symmetrical fault levels are to be assumed for initial design considerations.

1. 11 KV over head supply line 200 MVA arms
2. 400 Volt bus-bars (second terminals of LV supply transformers 30 MVA arms

B. It shall be the responsibility of the contractor to ascertain the true fault levels.

2.25 ELECTRICITY SUPPLY BY UTILITY COMPANY

A. 33/11 KV Systems

1. Most existing sites already have a high voltage supply, usually at 11KV, consisting of a 3-phase overhead transmission line which terminates at the Works.

2. The present policy of the EWASA is to provide drop-out fuses at high voltage for transformers up to, and including, 500 KVA. The Company will also provide and install the HV cable between overhead line and transformer. It shall be the responsibility of the Contractor to provide the low voltage cable and protection equipment.

3. A high voltage circuit breaker shall be provide where the transformer rating exceeds 500KVA. It shall be complete with over-current and earth fault protection and shall be housed in a suitable building. Provision shall also be made for the supply and installation of metering for the incoming supply comprising the following:

KW	max. demand indication
KWH	integrating meter
KVA	max. demand
KVAH	integrating meter
KVAR	max. demand
KVARH	integrating meter

4. The necessary C.T.'s and V.T' s for metering shall also be provided and these shall comply with the relevant UEDCL standards, which are currently as follows:

5. Current transformers shall be ration 100/50/5 A for use at 50 Hz having a burden of 15 VA at Class 'C'.

6. Voltage transformers shall be of the ratio 11000/110 volts for use at 50Hz having a secondary burden of 100 VA per phase at Class 'B'.

7. A suitable battery and battery charger shall be installed in the 11 KV sub-station for switchgear tripping duties.

B. 11KV Switchgear

1. The circuit breakers shall be of the vacuum interrupter or small oil volume type, mounted on a withdrawal truck inside a metal cubicle. The operation of the breaker shall be by hand or motor charged spring mechanism.

2. A panel shall be provided on the cubicle (or may form an integral part of the cubicle) which shall houses the over-current and earth fault relay. The necessary C.T. and this relay shall be mounted in the switchgear cubicle.

C. Over-current and Earth Protection

1. The over-current and earth fault protection shall comprise an integral system. The characteristics of the relays and other protection devices shall be selected so that acceptable discrimination is obtainable from the source, to the pump motors.

2. The Contractor shall show to the satisfaction of the Engineer that the system proposed shall provide an entirely satisfactory installation for the operation of the plant and safety of the personnel working there.

3. The Engineer shall approve the proposal upon submission by the Contractor of curves illustrating the time/current characteristics and discrimination of all protective elements.

4. Relays shall be suitable for use with current transformers having a 1A secondary output. They shall be of the electromagnetic type and shall be contained in dust protected cases to 1P 50 and fully tropicalised.

D. Transformer Protection (1000 KVA Rating)

1. A double-float Buchholz relay and a winding temperature indicator with alarm and trip settings shall be include`ed with the transformer fittings. The indicator shall be mounted on the same panel as the overcurrent and earth fault relay.

2.26 COMMUNICATIONS AND TECHNOLOGY

A. Basic Communications Compliance with Regulations

1. This Section includes general administrative and procedural requirements for the Communication Systems. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.

2. Work executed under this Section shall be performed in accordance with all applicable requirements of the latest edition of all governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

3. Underwriter's Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
   a. UL 444: Communications Cables
   b. UL 497: Protectors for Paired-Conductor Communication Circuits
   c. UL 1651: Optical Fiber Cable
   d. UL 1690: Data-Processing Cable
   e. UL 1963: Communications-Circuit Accessories
   f. UL 2024A: Optical Fiber Cable Routing Assemblies.

4. ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard

a. Part 1: General Requirements
b. Part 2: Balanced Twisted-Pair Cabling Components
c. Part 3: Optical Fiber Cabling Components Standard

5. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces, including the following addenda:

a. TIA/EIA-569-A-1 Perimeter Pathway Addendum
b. TIA/EIA-569-A-2 Furniture Pathways Fill Addendum
c. TIA/EIA-569-A-4 Poke-Thru Devices
d. TIA/EIA-569-A-6 Multi-Tenant Pathways and Spaces
e. TIA/EIA-569-A-7 Cable Trays and Wireways

6. ANSI/TIA/EIA-598-B Optical Fiber Cable Color Coding

7. ANSI/TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure

8. ANSI/J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

9. EIA testing standards

B. Insulated Cable Engineers Association (ICEA):

1. ANSI/ICEA S-80-576-2002 Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems
2. ANSI/ICEA S-83-596-1994 Fiber Optic Premises Distribution Cable
3. ANSI/ICEA S-87-640-1999 Fiber Optic Outside Plant Communications Cable
4. ANSI/ICEA S-90-661-2002 Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems
5. ICEA S-104-696-2001 Standard For Indoor-Outdoor Optical Cable

C. Building Industry Consulting Services International (BICSI):

1. Telecommunications Distribution Methods Manual (TDMM)
2. Wireless Design Reference Manual (WDRM)
3. Network Design Reference Manual (NDRM) .

2.27 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the

specifications are met. Include in the program minimum provisions for:

a. Incoming inspection of raw materials
b. In-process inspection and final inspection of the cable product
c. Calibration procedures of test equipment to be used in the qualifications of the product
d. Recall procedures in the event that out of calibration equipment is identified.

B. Contractor Qualifications:

1. A current, active, and valid and Contractors License.
2. Five continuous years, minimum, experience
3. Five, minimum, completed projects similar to scope and cost.
4. Evidence of technicians qualified for the work.
5. Materials:

C. Provide new materials and equipment without defects. Provide only specified products and equipment, or products and equipment that have been approved in writing by the owner.

D. Regulatory Requirements: Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the Local Fire Regulations, Rwanda Utilities Regulatory Authority or any local governing municipality having authority and jurisdiction. Conform all Work under these specifications to the most stringent of the applicable codes. Provide the quality identified within these specifications and drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction. Conform to government standards on quality assurance for applications within these specifications.

2.28 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays. Comply with manufacturer's requirements for each product. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic. Storage outdoors covered by rainproof material is not acceptable. Provide heat where required to prevent condensation or temperature related damage. Damaged equipment shall not be installed. The Contractor shall replace, at no cost to the Owner, damaged equipment and return equipment to manufacturer. The Contractor shall be careful to prevent internal component damage, breakage, denting and scoring.

2.29 WARRANTY

A. Render service within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner. The warranty period for all copper and fiber optic cabling systems shall be 15 years from the date of acceptance. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within a 24 hour period during the warranty period. Warrant installed hardware, under normal use and service, to be free of defects and faulty workmanship during the warranty period. Keep the system in operating condition at no additional material or labor costs to the Owner during

the warranty period.

2.30 SUBSTITUTIONS

A. Where items are noted as "or equal", a product of equivalent design, construction and performance will be considered. Include in the Product Data submittal all catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified. Only one substitution will be considered for each product specified. No substitution of material, processes or equipment shall be permitted without written authorization to the Owner or Owner's Representative.

B. The Contractor shall be responsible for all expenses in connection with the substitution materials, processes and equipment, including the effect of his substitution on him, his subcontractor's or other Contractor's work.

2.31 1COMMUNICATION PATHWAYS

A. Device Boxes

1. Device box shall be C ETL US Listed for Class 2 and Class 3 power-limited (data, signal, and remote control) circuits Dimensions: 5 in square x 2.875 in deep, Device box shall come equipped with integrated cable management/slack support.

B. Manufacturers:

1. Randl Industries or equal
2. #T-55017; "5 Square" device box, knockouts: one 1" + one 1-1/4" per side, one 1/2" per back
3. Siemon or equal
4. #B55-03; "5 Square" device box, knockouts: one 1" + one 1-1/4" per side, one 1/2" per back

2.32 CABLE BASKET

1. Suitable for the support & management of telecommunications cables, either overhead or mounted vertically on a wall. Cable basket shall be made of steel wires and formed into a standard 2-inch by 4inch or 2-inch by 2-inch wire mesh pattern. Wire intersections shall be welded. Wire ends along sides (flanges) shall be rounded during manufacturing for safety of installers and to prevent damage to cables. Material: Carbon steel wire, ASTM A510, Grade 1008. Wire welded, bent, and surface treated after manufacture. UL Classification: UL#E556 Finish: Electro-plate straight sections yellow zinc dichromate SC2. Fittings: Field fabricated in accordance with manufacturer's instructions from straight sections. Size: Refer to Drawings for cable basket sizes. Accessories:

2. Grounding: Terminal support and cable support for attachment on tray of continuous ground conductor fixing system, pre-galvanized steel.

3. Electro-plated zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. Threaded components shall be coated in accordance with ASTM B633 SC1.

4. Cable Label Clips: Mark and identify specific cable runs, electro-zinc plated steel.

B. Manufacturer:

1. Cooper B-Line or equal
2. B-Line #FT4X8X10, 4”H x 8”W x 120”L cable basket straight section or
3. B-Line #FT4X12X10, 4”H x 12”W x 120”L cable basket straight section
4. B-Line #FTS23SK, splice plate kit for 4” and 6” deep Flextray
5. Or equal by Cablofil/Ez-Tray Series or GS-Metals/FlexTray Series

2.33 DROP WIRE

A. Suitable for indoor installation within ceiling space into hard concrete floor for the support of cable support devices such as cable hangers. For underfloor distribution system a custom-made solution shall be provided.

B. Manufacturers: Hilti or equal

1. #CC27 X-AL-H22P8T 4 ft. PT (100); drop wire assembly, 4 foot wire
2. #CC27 X-AL-H22P8T 6 ft. PT (100); drop wire assembly, 6 foot wire
3. #CC27 X-AL-H22P8T 8 ft. PT (100); drop wire assembly, 8 foot wire
4. #CC27 X-AL-H22P8T 10 ft. PT (100); drop wire assembly, 10 foot wire
5. #CC27 X-AL-H22P8T 12 ft. PT (100); drop wire assembly, 12 foot wire

2.34 CABLE TRAY PATHWAYS

A. Location of cable tray and surface raceway shall be planned in advance of the installation and coordinated with ductwork, plumbing, ceiling and wall construction in the same areas, and shall not unnecessarily cross other conduits or pipe, nor prevent removal of ceiling tiles or panels, nor block access to mechanical or electrical equipment. Provide offsets as required to avoid obstruction of cable trough with other trades.

2.35 CABLE HANGERS

A. Use Cable hangers only in areas with tiled accessible ceiling and underfloor. Provide cable hanger system, consisting of hangers, drop wires, threaded rod, and other required accessories, from primary pathways to device pathways and/or device locations. Install in accordance with manufacturer’s instructions and with recognized industry practices. Provide dedicated supports at intervals up to 48 inches on center, per a given route. Supports shall consist of #12 drop wire or one-quarter inch threaded rod, depending on the cable hanger’s or strap’s requirement. Suspend wire, or rod, using components appropriate for the structure – e.g., powder-actuated clip fastener for drop wire, beam flange clip or angled flange clip for either wire or rod, or an embedded anchor for the threaded rod. Do not share support (wire/rod) with other trades. Do not

support the hanger on ceiling grid support wires. Do not support the hanger from ductwork, piping, or other equipment hangers. Install hangers so they are accessible through the ceiling grid and are not blocked by other building infrastructure. Provide a cable hanger within 24 inches of any transition downward/upward, such as into a device stub. Installation Clearances: Installation above ceiling grid such that cable's loops and runs do not rest on the grid, or ~ 6 to 12 inches above ceiling grid Cables, at full deflection, shall not rest upon any other structure From fluorescent light fixtures, or other EMI sources = 6 inches, minimum From any motor = 4 feet, minimum Parallel to flue, hot water, steam line or other heat producing source = 12 inches, minimum; crossing perpendicular to the runs = 3 inches Close cable hanger loop, retainer, or latch after cable installation.

2.36 COMMUNICATIONS TWISTED PAIR TESTING

A. Testing Scope of Work

B. Section Includes: Testing of Telecommunications Horizontal Cabling subsystem. All testing shall comply with TIA/EIA Standards.

C. Definitions

1. In addition, define the following list of terms as used in this specification as follows:

2. "CAT5E": Shall mean Enhanced Category 5 cabling, per ANSI/TIA-568-C.2
3. "CAT6": Shall mean Augmented Category 6 cabling, per ANSI/TIA-568-C.2
4. "Channel": Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.
5. "Connect": Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
6. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper".
7. "Permanent Link": Shall mean the 'permanent' portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.
8. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

D. The manufacturer may change the product numbers listed in this Section at any time. In the event this Section contains an invalid product number or conflicts with the written description, notify the Engineer in writing prior to issuing submittals or field testing.

E. Backbone UTP Cabling Testers

F. DSX 5000 Copper Tester
1. Areas of Test Measurement (minimum): Wire Map (continuity, opens, shorts, crossed pairs, split pairs): Fluke Tester.
2. Areas of Test Measurement (minimum): Length: Harris #TS-90 test unit

G. Category 6 Horizontal Cable Tester

1. Equipment shall be independently verified to meet ANSI/TIA-1152 requirements, including Level IIIe minimum accuracy. Equipment shall meet ISO/IEC Class C, D, E, and F.
2. Test Standards (minimum): ANSI/TIA-568-C.2 Category 6A; ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5
3. Areas of Test Measurement (minimum): test areas listed under ANSI/TIA568-C.2, 6.3
4. Equipment:
   a. Fluke Networks
      1. Fluke DSX 5000 test kit (main unit, remote unit, CAT6 permanent link adapters, CAT6 channel adapters.
      2. "LinkWare" Live reporting and latest version of documentation software.

2.37 Category 5E Horizontal Cable Tester

A. Equipment shall meet TIA/EIA-568B.2 requirements for Level V accuracy.

B. Test standards (minimum): TIA Category 5e (per TIA TIA/EIA-568B.2); ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5

C. Areas of Test Measurement (minimum): Wire Map; Length; Insertion Loss; Near End Crosstalk (NEXT) loss, at both master unit and remote unit; Power Sum NEXT (PSNEXT) loss, at both master unit and remote unit; Equal Level Far End Crosstalk (ELFEXT), at both master unit and remote unit; Power Sum ELFEXT, at both master unit and remote unit; Return Loss (RL), at both master unit and remote unit; Propagation Delay and Delay Skew; Attenuation-to-Crosstalk Ratio (ACR), at both master unit and remote unit; Power Sum ACR (PSACR), at both master unit and remote unit; Characteristic Impedance; DC Loop Resistance.

D. Equipment

1. FLUKE DSX-5000 Cable Analyzer equipped with a DTX CHA001 Channel/Traffic Adapter for CAT6/ClassE; Version 6 (for both the MAIN TESTER UNIT and the Smart Remote) utilizing with LinkWare Live Software

2.38 RECORDS

A. Permanently record all test results. Submit test results in native FLW format to Owner before system acceptance. Hard copy is required for fiber OTDR/Power Meter and copper backbone.

B. Submit this information at the conclusion of the testing to the Engineer for approval.

C. Include approved test reports in final record documents submittal.

D. Separate test results by Category 5E voice, Category 5E data, and Category 6 data.

E. For each Horizontal Category 5E and Category 6 test record the following information:

1. Project name and address.
2. Contractor's name.
3. Date of measurement.
4. Ambient temperature.
5. Test equipment, including the following:
   a. Manufacturer, model, and serial number
   b. Date and time of last calibration.
6. Operator's name(s).
7. Identification number of cable.
8. Overall test result.
9. Termination style (patch panel or 110-block).

2.39 TEST RESULT TEMPLATE

Pair No.	Continuity end- (Yes/No)	Short (Yes/No)	Pair Reversal (Yes/No)	Cross Pairs (Yes/No)	Split Pairs (Yes/No)	Loop Resistance (Ohms)	Transposition (Yes/No)	Ground [Protector panel (Yes/No/NA	Test/Observation Comments: [If pair fails record distance at fail point, in Ft]
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
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25									

2.40 COMMUNICATION FIBER TESTING

A. Section Includes: Testing of Communications Fiber Optic Cabling (Backbone Cabling

subsystem).

B. Fiber Testing References

1. In addition, the following standards are referenced to this Section:
2. TIA/EIA-526-7 ("OFSTP-7") Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant
3. EIA/TIA-455-77 (FOTP-77), "Procedures To Qualify A Higher-Order Mode Filter For Measurements On Singlemode Fibers"
4. EIA/TIA-455-78A (FOTP-78), "Spectral-Attenuation Cutback Measurement for Singlemode Optical Fibers"
5. EIA-455-95 (FOTP-95), "Absolute Optical Power Test for Optical Fibers and Cables"
6. EIA-455-171 (FOTP-171), "Attenuation By Substitution Measurement – For Short-Length Multimode Graded-Index And Single-Mode Optical Fiber Cable Assemblies"
7. American National Standards Institute (ANSI) Z136.2, "American National Standard for the safe use of optical fiber communication systems utilizing laser diode and LED sources"
8. BICSI Telecommunication Distribution Methods Manual.

C. Fiber Testing Definitions

1. "Adapter" (associated with fiber connectivity): Shall mean a connecting device joining 2 fiber connectors, either like or unlike.
2. "Connect": Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.
3. "Cord": Shall mean a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper".
4. "OTDR": Shall mean Optical Time Domain Reflectometer.
5. "Passive Link Segment": Shall mean the cable, connectors, couplings, and splices between two fiber optic termination units.

Subsystem	Type	Test	Direction	Wavelength
Backbone	Singlemode	Passive Link Ins. Loss	Both	1310nm and 1550nm
Backbone	Singlemode	Optical Power Loss	Both	1310nm and 1550 nm

6. "System Cord": Shall mean the cord used in the operating electrical or optical circuit.
7. "Test Cord": Shall mean the cord certified for use in testing, as described in this section.

2.41 FIBER OPTIC LIGHT SOURCE

A. Connection interfaces shall be factory installed. Output shall be continuous wavelengths. The light sources may contain internal lenses, pigtails, and modal conditioners, provided they meet the

launch conditions as described in "Post-Installation" Passive Link Attenuation Testing Procedures (ref. PART 3 - EXECUTION). LASER-based light source for singlemode fiber testing shall have a Center wavelength of 1310n · 20nm and 1550n · 20nm., Spectral width (FWHM) of · 5nm at 1310nm and · 5nm at 1550nm, and minimum output power level of · 3dBm.

B. Equipment:
   1. Fluke Networks
      a. #DSX-5000; Test Kit – or bundled kit
      b. "SimpliFiber" Test Kit
      c. #Fluke Certifiber Pro Loss Length, Power Module
   2. Corning Cable Systems
      a. #OS-404RXD; dual wavelength (1310 / 1550) light source for singlemode
   3. Exfo
      a. #FOT-930; OLTS test set
      b. #FOT-600 OLTS test set (#23BL Source + #602X Meter)
      c. #FOT-300; OLTS test set
   4. Agilent Technologies' WireScope 350 test set
      a. #450-2020 Fiber SmartProbe testing adapter, singlemode 1300nm.
      b. ScopeData management software (version 5.20).
   5. Laser Precision
      a. #5150 test set

2.42 FIBER OPTIC POWER METER

A. Power meter for both multimode and singlemode testing shall be capable of measuring relative or absolute power (or both), and must be independent of modal distributions. Power meter used shall have a: Dynamic range of 0dBm to -40dBm, minimum, and have Accuracy of · 0.2dB. Power meter shall be factory calibrated.

B. Equipment:
   1. Fluke Networks
      a. #DSX-5000; Test Kit – or bundled kit
      b. "SimpliFiber" Test Kit
      c. #Fluke Certifiber Pro Loss Length, Power Module
   2. Corning Cable Systems
      a. #OTS-610; power meter with data storage
      b. #OTS-410R power meter
   3. Agilent Technologies' WireScope 350 test set
      a. #450-2020 Fiber SmartProbe testing adapter, singlemode 1300nm.
      b. ScopeData management software (version 5.20).
   4. Laser Precision
      a. #5025 test set

2.43 FIBER OPTIC OTDR

	Range	Deadzone	Deadzone	Resolution	Accuracy
1310nm	40dB	6.0mt	3.5mt	0.001dB	0.1mt
1550nm	28dB	12.0mt	3.5mt	0.001dB	0.1mt

Singlemode Source Module: Wave length Dynamic Attenuation Reflective Loss Distance

A. Equipment:
   1. Fluke Networks or equal
      a. #OF-500; "OptiFiber" OTDR mainframe – or bundled kit
      b. #OFTM-5730; Singlemode module for OptiFiber OTDR
      c. #OFP-QUAD; Opti Fiber Pro, Quad OTDR Module

B. Reader Software: Windows-based software capable of reading stored traces and is fully functional with the testing equipment.

2.44 FIBER OPTIC TEST CORDS

A. Singlemode Fiber Optic Test Cords shall conform to TIA-526-14A, 3.1.3. The fiber of the singlemode test cord(s) shall have the mode field diameter nominally equal to that of the singlemode fiber optic passive link. Test cords length for testing insertion loss: 1m – 5m. Connectors of the test cords shall be compatible with the connector types of the light source and the power meter, and with the cabling plant. The connectors shall exhibit <= 0.5dB loss per connection @ both 1300nm and 1550nm, as measured per FOTP-171 D3. The connectors shall inhibit Fresnel reflections (i.e., have a "PC" finish).

2.45 PASSIVE LINK INSERTION LOSS TESTING REQUIREMENTS AND PROCEDURES

A. Test fiber optic passive links per "Base Bid Work" in Part 1 of this Section.

B. Precautions

   1. Adhere to the precautions described in TIA-526-14A, 5.1.
   2. Adhere to the equipment manufacturer's instructions during all testing.
   3. Prior to any testing activity or any measurements taken:
      a. Ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
      b. Power on the light source and power meter for at least 5 minutes.
      c. Clean all test cords & system cords (if applicable) connectors and all adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
   4. Do not power off the light source or the power meter during testing activity.
   5. Do not remove Test Cord #1 from the light source at any time (unless the testing is complete or the equipment is being put away for the evening).
   6. Do not bend the test cords smaller than 20 times the cord diameter (this may induce loss into the cord reducing the accuracy of the measurement).

C. Test Cords Performance Verification

   1. Connect Test Cord #1 between the light source and the power meter.
   2. The value displayed on the power meter is the reference power (Pref) measurement. If the power meter has a relative power measurement mode, enter this reference power

measurement (Pref) value into the meter. If it does not, hand-write Pref onto the record documents for future reference.

3. Disconnect Test Cord #1 from the power meter. Do not disconnect Test Cord #1 from the light source.
4. Connect the 'open' end of Test Cord #1 to an adapter (of matching connector type). Connect one end of Test Cord #2 to the adapter and the other end of Test Cord #2 to the power meter.
5. The value displayed on the power meter is the power measurement (Psum). If the power meter is in Relative Power Measurement Mode, the meter reading represents the test cord #2 connection attenuation. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the connection attenuation:
   a. If Psum and Pref are in the same logarithmic units (dBm, dBu, etc): Connection Attenuation (dB) = $\left| \text{Psum} - \text{Pref} \right|$
   b. if Psum and Pref are in watts: Connection Attenuation (dB) = $\left| 10 \times \log10 [\text{Psum}/\text{Pref}] \right|$.
   c. The measured connection attenuation must be less than or equal to the value found in Table 3 (below).
6. Flip the ends of Test Cord #2 so that the end connected to the power meter is now connected to the adapter, and the end connected to the adapter is now connected to the power meter.
7. The meter reading is the reversed Power Measurement (Psum). Perform the proper calculations if not using Relative Power Measurement Mode.
8. Verify that both connection attenuation measurements are less than or equal to the value found in Table 3 (below).
9. If both measurements are found to be less than or equal to the values found in Table 1, test cord #1 is acceptable for testing purposes. Unacceptable attenuation measurements may be attributable to test cord # or test cord #2. Examine each cord with a portable microscope and clean, polish, or replace if necessary.
10. Repeat this test procedure from the beginning reversing the test cords in order to verify the performance of test cord #2.

D. Test Equipment Set Up

1. Follow the test equipment manufacturer's initial adjustment and set up instructions.
2. If the power meter has a Relative Power Measurement Mode, select this mode.
3. If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
4. Set the light source and power meter to the same wavelength.
5. Use 300m SM launch cables for passive link insertion testing.

E. Singlemode Passive Link Insertion Loss Testing Procedures

1. Determine Launch Conditions:
   a. Use the launch conditions, as described in FOTP-78.
   b. Employ a method to remove high-order propagating modes, as described in FOTP-77.
2. Test Methods: Perform the passive link insertion loss testing of singlemode fibers according to "Test Method A.1: One Jumper Measurement", per OFSTP-7.
   a. After setting up the test equipment and verifying the performance of the test cords, the insertion loss of the passive link segments can be measured.
   b. Connect test cord #1 between the light source and the power meter.

c. The meter reading is the Reference Power Measurement (Pref). If the power meter has a Relative Power Measurement Mode, enter the Reference Power Measurement (Pref) value into the meter. If it does not, hand-write Pref for future reference and to be included in the Record Documents.
d. Disconnect test cord #1 from the power meter. Do not disconnect test cord #1 from the light source.
e. Connect test cord #1 to the passive link segment 'input'.
f. At the opposite end of the passive link segment, connect test cord #2 to the link segment 'input' and the power meter.
g. The meter reading is the Power Measurement (Psum). If the power meter is in Relative Power Measurement Mode, the meter reading represents the insertion loss. If the meter does not have a Relative Power Measurement Mode, perform the following calculation to determine the insertion loss:
    1. If Psum and Pref are in the same logarithmic units (dBm, dBu, etc): Link Segment Attenuation (dB) = $\left|\text{Psum} - \text{Pref}\right|$
    2. If Psum and Pref are in watts: Link Segment Attenuation (dB) = $\left|10 \times \log10 [\text{Psum}/\text{Pref}]\right|$
h. Record Psum for inclusion into the Record Documents.

F. Acceptable Measurement Values

1. Remove and replace any cabling links failing to meet the criteria described in this specification at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.
2. The general insertion loss equation for any link segment is as follows:
    a. Insertion loss = <cable loss> + <connection loss> + <splice loss> + <CPR adjustment>.
    b. Note: A connection is defined as the joint made by two mating fibers terminated with remateable connectors (e.g., ST, SC, etc).
3. Singlemode Attenuation Coefficients
    a. Cable Loss = Cable Length (km) x (0.35 dB/km @ 1310-nm or 0.20 dB/km @ 1550-nm) for OSP and (1.0 dB/km @ 1310-nm or 1.0 dB/km @ 1550-nm) for ISP.
    b. Connection Loss (ST or SC Connectors) = (Connections x 0.44 dB) + 0.42 dB
    c. Connection Loss (Other mini-connectors) = (Connections x 0.24 dB) + 0.24 dB
    d. Splice Loss = Splices x (0.07 dB for fusion or 0.15 dB for mechanical)
    e. CPR Adjustment = Not applicable for singlemode.

G. Record Documents:

1. Permanently record all test results.
2. Submit test results in a format acceptable to the Owner, or Owner's Representative, or Engineer before system acceptance.
3. Cable and fiber identifiers of the test reports shall match the identifiers as labeled in the field – i.e., use the same ID on the cable label/fiber port label as what is entered into the stored test result in the power meter.
4. Measurements shall carry a precision through one significant decimal place, minimum.

5. Passive Link Insertion Loss Testing: Each test report shall contain the following information (not necessarily in this order):
   a. Project name
   b. Cable identifier, fiber number, and fiber type (e.g., "singlemode")
   c. Operator (company and name)
   d. Date measurement were obtained,
   e. Measurement direction
   f. Wavelength
   g. Loss measurement
   h. Test equipment model and serial number(s)

2.46 CHARACTERIZATION TESTING REQUIREMENTS AND PROCEDURES

A. Safety: Use test equipment containing a laser or LED in accordance with ANSI Z136.2.

B. Test fiber optic passive links per "Base Bid Work" in Part 1 of this Section.

C. Precautions
   1. Adhere to the equipment manufacturer's instructions during testing.
   2. Prior to testing activity or measurements taken, complete the following activities:
      a. Ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).
      b. Turn the light source and power meter power on for at least 5 minutes.
      c. Clean test/launch cords' and system cords' connectors and the cabling system adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.
   3. Do not power off OTDR's light source during testing activity.
   4. Do not remove launch cord from the OTDR's light source at any time (unless the testing is complete or the equipment is being put away for the evening, or during trouble shooting).
   5. Do not bend the launch cord smaller than 20 times the cord diameter during testing activities (this may induce loss into the cord reducing the accuracy of the measurement).

D. Characterization Testing Procedures

   1. Equipment settings / measurement parameters:
      a. Index of Refraction: match cable-under-test fiber parameters; default settings as follows:

         Singlemode Corning SMF-28e+ 1.4670 @ 1.4677 @ 1550nm
         1310nm

      b. Pulse Width:

   2. Singlemode 10 ns for cable lengths up to 2,000 meters
      1. 50 ns for cable lengths between 2,000 meters and 10,000

Table 270812-3.1: Acceptable Test Cord Connection Attenuation

	ST or SC Cord	Mini-Connector Cord
Singlemode	0.55 dB Max	0.30 dB Max

2. meters
   b. Backscatter: singlemode: -74dB @ 1310nm and 1550nm
   c. Event Threshold: 0.05dB.
   d. Reflection Threshold: singlemode: -60dB.
   e. Fiber Break/End-Of-Fiber: 3dB
3. Set the distance units (i.e., the "X" axis of the graph) to <feet> <meters>.
4. Waveform: The waveform shall be real-time and normal density.
5. Obtain measurements using a 'launch' cord connected to the test instrument and the cable-under-test.
   a. The fiber of the launch cord shall match the fiber of the cable-under-test in physical and performance parameters (such as type, core/cladding size, index of refraction, refractive profile). The fiber of the launch cord should match the fiber of the cableunder-test in manufacturer and product.
   b. The launch cord length shall be between 25 and 100 meters.

E. Record Test Measurements:

1. Utilize Fluke Linkware Live Software for all Fiber Optic Test Measurements

2.47 Communications Equipment Rooms

A. Rack Bay Systems

1. Suitable for the support of cable termination devices, management devices, common communications equipment, and other similar equipment. Material: High strength, lightweight 6061-T6 aluminum, extrusion construction. Channel: Size: The mounting channels shall be 3" deep by 1.265" wide with a 0.17" thick web. Flange: The mounting channels shall have front and back mounting flanges ("double sided"). The flanges shall be 0.25" thick, and shall have mounting holes front and back. Mounting Holes: The hole pattern shall be industry standard spaced at 5/8" - 5/8" - 1/2", compatible with ANSI/EIA-310-D (1992) standard. The mounting holes shall be pre-threaded as #12-24 rolled threading. Assembled Rack: The rack shall come complete with base angles (3.5" high by 6" deep by .375" thick) and top angles (1.5" high by 1.5" deep by .375" thick). The assembled rack shall be 7'-0" high (overall) by 19" mounting width (20.25" wide overall), and shall contain 45 EIA mounting spaces (1.75"). Rack shall be UL listed. Include 50 mounting screws. Include all required accessories, such as floor installation kit, etc. for a complete installation.

2. Manufacturer: CPI or equal
   a. #48353-503, 7'-0"H x 19" UL equipment rack, clear
   b. #11592-101, Rack Seismic Gusset Kit

B. Vertical Management Sections
1. Double Sided Rack Vertical Management Sections. Suitable for cable routing (back) & cord slack storage (front) vertically from the bottom of the rack to the top. The vertical management sections shall be double sided (i.e., the management section shall have routing guides on the front and rear). Size & Capacity: 7'-0" high by 6"-10" wide, with 6" deep cable storage capacity in back and 6" cord storage capacity in front. Mounting: The vertical management section shall have matching bolt holes for attachment to the

rack.

a. Manufacturer: CPI or equal
b. #30095-503, vertical mngt section, 7’-0”H x 6”, double sided.
c. #30096-503, vertical management section, 7’-0”H x 10”, double sided.

C. Cable Management Devices

1. Horizontal Management Panels: Suitable for installation into equipment rack for cord routing (front). Size & Capacity: 2U high Manager shall have large management rings.

2. Manufacturer:
a. Siemon or equal
b. #RS-RWMG-2, Single Sided 19” cable manager with 6” fingers, 2U

2.48 PATHWAYS

A. Cable Runway

1. Suitable for the support & management of communications cables, mounted vertically on a wall. Material (both stringer and rung): Steel tube, rectangular, 1-1/2” by 3/8” by 0.65” wall thickness. Rungs: 12” on center, welded to stringer. Size: 9’ 11-1/2” straight sections; width: refer to Drawings.

2. Manufacturer: CPI or equal
a. #10250-118, 18”wide universal cable runway, gray
b. #10250-124, 24”wide universal cable runway, gray
c. #10608-001, vertical wall bracket kit
d. #10642-001, end caps
e. #10596-106, cable retaining post 6”H
f. #16302-101, junction kit
g. #10487-101, butt-swivel splice kit
h. #11085-001, threaded rod cover
i. #10642-001, protective end caps
j. #P254224, Horizontal Wall Bracket – By Unistrut Services

B. Fiber Trough

1. The fiber duct shall be constructed of flame retardant PVC polycarbonate material UL94-VO rated and shall be Yellow in color. Assembly: Fiber trough system shall consist of straight sections (trough) and related installation and routing accessories. The system shall comply with NEC 770-51 and UL2024 requirements for General Purpose Fiber Optic Raceways. Color: All components shall be Yellow. Sizes and Dimensions: The duct used overhead shall be 4 inch by 4 inch. A complete system shall include all necessary duct, covers, fittings, and fastening/support components.

2. Manufacturer:

a. ADC or equal
    1. #FGS-MSHS-A, 4” high by 4” wide straight section 6ft in length
    2. #FGS-HMEC-A, 4” high by 4” wide end cap
    3. #FGS-HTUB-5/8, center support bracket
    4. #GS-MDSP-A, 4” Down Spout
    5. #FGS-MCDS-AB: 4” Down Spout Cover
    6. #FGS-HNTS-XX-LP, Low Profile C-Bracket
    7. #FGS-HLDR – ½, ladder racket bracket kit

C. Rack Mounted Power Distribution Unit

1. Vertical Equipment Rack Metered PDU. 63 ¾” long power strip with a 10’ long cord. Current Rating: 20 Amps. Output (24) NEMA 5-20R. Input (1) NEMA L5-20P

2. Manufacturer:

    a. APC or equal (no known equal)
    b. Server Tech #C-12V1-C20M

D. Rack Shelf Unit

1. Rack Shelf: The rack shelf shall be 19” rack mounted shelf and storage drawer unit with keyed lock. The rack shelf shall be 4 RMU in height. One per TR (BDF, IDF).

2. Manufacturer:
    a. CPI or equal
        1. #13084-519 Rack Storage Drawer, or equal, no known equal

E. IT Wall Mounted Cabinets

1. Cabinet: The cabinet shall be 24” by 36” wall mounted. The cabinet shall be 12 RMU in height, and provide ventilation, lockable door.

2. Manufacturer:
    a. Cooper Industries B-Line or equal
        1. V-Line Dual Hinge Wall Mount Cabinet or equal,

2.49 COMMUNICATIONS BACKBONE ISP UTP Cabling

A. Backbone ISP (inside plant/indoor) twisted pair cabling.

B. Definitions

1. “CMP”: Communications Media Plenum [NEC plenum rating]
2. “CMR”: Communications Media Riser [NEC riser/non-plenum rating]
3. “ISP”: Inside Plant [cabling]
4. “PE”: Polyethylene
5. “PIC”: Plastic Insulated Conductor

6. “PVC”: Polyvinyl Chloride

2.50 INSTALLATION

A. Backbone Cable

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere. Placement: Place cables within designated pathways. Maintain a minimum bend radius of 6 times the cable diameter during and after installation. Maintain pulling tension within manufacturer's limits. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables if damaged during installation Place a pull rope along with cables where run in conduit and spare capacity still exists in the conduit. Tie off ends of the pull rope.

2. Routing: When routing horizontally within telecommunications rooms, utilize the upper level of overhead cable support. When routing vertically within telecommunications rooms, utilize the vertical cable support and provide cable ties every 24 inches on center using approved cable ties (Velcro straps only). Route cables a minimum of 6" away from power sources to reduce interference from EMI.

3. Termination: Provide 15 feet cable slack loop at each end of the run. Store slack in overhead cable support (level 2 cable runway). Properly strain relieve cables at termination points per manufacturer’s instructions. Terminate twisted pairs onto the termination apparatus in accordance with manufacturer’s latest instructions and TIA/EIA-568-B standard installation practices. Perform post-installation testing as described in the Telecommunication Testing specification.

4. Termination Apparatus:

a. Provide accessories required for a complete installation. Install the termination apparatus to the dimensions shown on the Drawings. Mount termination apparatus plumb and square. Labeling and identifier assignment and the label colors shall conform to the TIA/EIA-606A Administration Standard and as approved by Owner or Owner’s Representative before installation. Provide permanent and machine-generated labels; hand written labels will not be accepted.

5. Cable Labels

a. Label Format: Label type shall be wrap-around self-laminating. Label color shall be white background with clear laminating window. Text color shall be black; text height shall be 1/8” high, minimum, or #12 font size. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

6. Termination Apparatus Labels:

a. Use labels included in the product packaging. For substitutions, request approval by the Engineer. Label color shall be white and grey for respective field type, per TIA/EIA-606-A. Text color shall be black, 3/32" high, minimum, or #10 font size. Identifier Assignment Refer to drawings for labeling format requirements and examples for backbone cabling and termination apparatus.

2.51 COMMUNICATIONS BACKBONE ISP FIBER OPTIC CABLING

A. Backbone ISP Fiber Optic Cabling Definitions

1. "OFCP": Optical Fiber Conductive Plenum, plenum rating
2. "OFCR": Optical Fiber Conductive Riser, non-plenum riser rating
3. "OFNP": Optical Fiber Non-conductive Plenum, plenum rating
4. "OFNR": Optical Fiber Non-conductive Riser, non-plenum riser rating
5. "OFN": Optical Fiber Non-conductive, general purpose indoor rating
6. "PVC": PolyVinyl Chloride
7. "SM": Singlemode [fiber type]

B. Manufacturers:
1. Corning Cable Systems and TE Connectivity (substitutions allowed)

C. Fiber Optic Cable – Interlocked Armor Plenum Rated

1. Cable shall be suitable for indoor installation, between floors in vertical riser system and through overhead ceiling space (cable tray and conduit). Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging. Materials shall not absorb hydrogen in quantities that will increase light attenuation. Singlemode fiber strands shall meet or exceed the following geometry criteria:
   a. Core diameter = 8.3 · m.
   b. Mode field diameter = 8.8 · m, · 0.5 · m.
   c. Cladding diameter = 125 · m, · 1.0 · m.
   d. Core/Cladding Concentricity = · 0.8 · m.
   e. Minimum Tensile Strength = 100,000 psi.

2. Singlemode fiber strands shall meet or exceed the following performance criteria:

   a. Attenuation = 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm wavelengths, maximum.
   b. Cutoff wavelength = 1260 nm.
   c. Dispersion = 3.5 ps/nm · km at 1285-1330 nm.
   d. Primary Coating:
   e. Each fiber shall be completely covered with a "primary coating" (acrylate material).
   f. Coating diameter = 250 · m, · 5 · m.

D. Buffering:

1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 · m, · 5 · m. Material = PVC, or equivalent flame retardant thermoplastic.

2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)

E. Cable Sheath:

1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
2. Inner Jacket: The cable shall have a seamless inner jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).
3. Armor: The cable shall have an interlocking metallic armor applied spirally and longitudinally to and completely covering the cable.
4. Outer Jacket: The cable shall have a seamless outer jacket (material = PVC, or equivalent) applied to and completely covering the armor.
5. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
6. Flame Rating: rated as OFCP, and UL listed as such.

F. Manufacturer:

1. Corning Cable Systems or equal
   a. #024E88-33131-A3; 24 strand, singlemode, interlock armored (MIC), yellow, OFCP rated
   b. #024E88-33131-D3; 24 strand, singlemode, interlock armored (MIC DX), yellow, OFCP rated

2.52 FIBER OPTIC PATCH PANELS/TERMINATION APPARATUS

A. Fiber optic patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cable(s) and fiber strands, shall provide means to strain relieve and support of the specified cables, shall contain facilities to store fiber slack, and shall provide splice tray for patch cord management. Fiber optic patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting, and cross-connecting fiber optic cabling, shall possess a minimum fire resistant rating of UL94V-1, and shall conform to existing OSHA Health and Safety Laws.

B.

C. Fiber optic patch panels shall be rack-mountable. Fiber optic patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.

D. Manufacturer: TE Connectivity or equal
1. Singlemode Fiber
   a. #FL2-48TS875, 5RU 48-port panel for singlemode fiber
   b. #FST-DRS12-HS, splice wheel for heat shrink fusion
   c. #FL2-6P4SC05R, ST singlemode 6-pak connector plug in with pigtails
   d. #FLS-C270024PW-2A00

e. #FL2-C4700-48W-4A00

2.53 MISCELLANEOUS

1. Fiber Slack Storage Reel
   a. Manufacturer: Leviton or equal
      1. #48900-OFR, 24”w storage reel

2.54 INSTALLATION

A. Backbone Cable

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere. Maximum cable length of 300 meters from the termination between the local and far end.

B. Placement

1. Install cables within designated pathways. Bend Radius: Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation. Pulling: Maintain pulling tension within manufacturer's limits. Protection: Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Do not use cable-pulling compounds for indoor installations. Provide a 20 feet (minimum) sheathed cable slack loop at each end of the run within the Telecommunications Rooms; store slack in fiber slack storage reel mounted on the wall, above cable tray.

2. Place a pull rope along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull rope.

C. Routing

1. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via tie wraps or Velcro-type straps. When routing horizontally within telecommunications rooms, utilize the overhead cable tray/runway. When routing vertically within telecommunications rooms, utilize the wall mounted vertical cable runway and properly fasten. “Properly fasten” shall consist of cable ties in a ‘crossed’ configuration per cable or cable bundle (up to three cables or innerducts) every 24 inches on center.

D. Termination

1. Fusion splice singlemode fiber; pigtails to backbone cabling. Use splice wheels for the splices. Properly strain relieve cables at termination points (at/within the fiber optic termination panels) per manufacturer’s instructions. Terminate/connectorize fiber strands at both ends using the specified fiber optic connectors SC-UPC appropriate for the mode type of the fiber. Perform terminations in accordance with manufacturer’s instructions. Provide required accessories and consumables for the complete termination of fiber

strands. Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions.

E. Fiber Optic Cable Termination Panel

1. Provide fully assembled termination panel in designated equipment rack; locate per Drawings (if not shown, locate at the top). "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.
2.
3. Provide accessories required for proper installation of each termination panel, including connector panels and adapters. Terminate singlemode fiber optic cabling within separate termination panels, as shown on drawings.

2.55 LABELING

A. Labeling, identifier assignment, and the label colors shall conform to the TIA/EIA-606-A Administration Standard and as approved by Owner or Owner's Representative before installation. Provide permanent and machine generated labels; hand written labels will not be accepted.

B. Cable Labels

1. Label Format:
2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

C. Termination Apparatus Labels

1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
2. Label color shall be white and grey for respective field type, per TIA/EIA-606-A.
3. Text color shall be black, 3/32" high, minimum, or #10 font size.

2.56 COMMUNICATIONS BACKBONE OSP FIBER OPTIC CABLE

A. Backbone OSP Fiber Optic Cable Definitions
1. "HDPE": High Density Polyethylene
2. "LDPE": Light Density Polyethylene
3. "MDPE": Medium Density Polyethylene
4. "MM": Multimode [fiber type]
5. "PE": Polyethylene
6. "SM": Singlemode [fiber type]

B. Duct Plugs

1. Duct plugs for securing four 1-inch innerducts in 4-inch conduit.
2. Manufacturers:
   a. Tyco or equal #40Q136S; 4-inch quadplex plug

C. Duct plugs for securing one cable within one innerduct.
1. Manufacturer:
   a. Tyco or equal

   b. #10S035S; simplex plug for 1-inch ID innerduct and one fiber optic cable

D. Underground Fiber Optic Cables

1. Suitable for outdoor installations, in underground conduit. Rated tensile load: 200-lb. maximum rated load during pulling and 100-lb. maximum rated load after installation. The coated fiber strands within each sheath shall be color coded to allow identification of each fiber, and shall meet the requirements of ANSI/TIA/EIA-598-B. (Also, ref. ANSI/ICEA Publication S-80-576, and EIA-230). The optical transmission performance of the fiber shall not be significantly affected by environmental fluctuations, installation, or aging. All fibers shall be 'multi-tube' type loose buffered, around a dielectric central member, and filled with a water blocking element (gel) within the buffer tube. Cable sheath shall contain strength members (aramid yarn), a water blocking element (dry), be jacketed with a flame retardant material, and be all dielectric.

2. Singlemode fiber strands shall meet or exceed the following geometry criteria:

   a. Core diameter = 8.3 · m.
   b. Mode field diameter = 8.8 · m, · 0.5 · m.
   c. Cladding diameter = 125 · m, · 1.0 · m.
   d. Core/Cladding Concentricity = · 0.8 · m.
   e. Minimum Tensile Strength = 100,000 psi.
   f. Multimode fiber strands shall meet or exceed the following performance criteria:
   g. Attenuation = 3.5 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum.
   h. Bandwidth = 200 MHz km at 850 nm and 500 MHz km at 1300 nm wavelengths, minimum.
   i. Singlemode fiber strands shall meet or exceed the following performance criteria:
   j. Attenuation = 0.35 dB/km at 1310 nm and 0.2 dB/km at 1550 nm wavelengths, maximum.
   k. Cutoff wavelength = 1260 nm.
   l. Dispersion = 3.5 ps/nm · km at 1285-1330 nm.

3. Buffering:

   a. Loosely buffered fibers, either in a core tube or in multiple tubes around a dielectric central member.
   b. Flooded buffer tube/tubes containing filling compound to protect against moisture penetration. Filling compound: "FLEXGEL", or equivalent.

c. Buffer Tubes (applicable to multi-tube core configurations): Each buffer tube colorcoded to allow identification, and meeting the requirements of ANSI/TIA/EIA-598-A1995. (Also, reference ANSI/ICEA Publication S-80-576, and EIA-230).

4. Sheath:

a. Sheath shall consist of a strength member and an outer jacket, with non-metallic component dielectric sheath. Strength Member: Aramid yarn (e.g., Kevlar), or reinforced fiberglass rods. Jacket: PE (MDPE or HDPE). Rated tensile load: 600 lb. maximum rated load. Operating Temperature Range: -40 to 158°F (-40 to 70°C)

5. Manufacturer:
   a. Corning or equal
   b. #024EWP-T4100D20, 24 strand singlemode indoor/outdoor plenum cable.

2.57 SPLICING EQUIPMENT

A. Termination Equipment

1. Fiber Optic Patch Panels – BDFs

a. Passive fiber optic physical equipment and apparatus used in interconnecting and crossconnecting fiber optic cables shall possess a minimum fire resistant rating of UL94V-1. The equipment and apparatus shall have provision for the application of safety labels such as laser identification or warning labels as required by system considerations. Fiber optic patch panel shall be a fully assembled rack mounted fiber optic enclosed housing for protecting, storing and organizing the termination of the fiber cable and all fiber strands at each end of the cable. The patch panel shall include an integrated patching facility. The fiber patch panel must provide means of strain relief and support of the specified cables. Contain slack storage facilities for fiber slack. Support 48 (minimum) fiber terminations. Splice tray. “Fully assembled” shall include all required installation & mounting components, and include accessories such as connector panels, coupling adapters, etc. for a complete installation. Adapters: Multimode and Singlemode adapters shall be ST type. Color shall be beige.

2. Manufacturer:

a. ADC or equal
   1. #FL2-48RPNL; patch panel, 4U high
   2. #FL2-96RPNL; patch panel, 6U high
   3. #FL2-6PSMST, 6PAK ST Multimode Adapter Plug-in

B. Connectors

1. Singlemode Fiber Optic Pigtails
2. Pigtail connectors for all individual singlemode fibers, at both ends, shall be ST type. Pigtail assemblies shall have (12) ST connectors on one end and stub on the other.

Individual fiber shall be color coded, have a diameter of 900 microns and bundled in a soft wall jacket.

3. Manufacturer:
   a. Corning or equal
      1. ADC #E-501-L22, 12 strand single mode ST pigtail, or equal
      2. ADC #FST-DRS12-FT, bare fusion splice wheel

C. Outside Plan Innerduct

1. Outside plant innerduct shall be suitable for an outdoor installation within an underground conduit system for the support of telecommunications cables (mainly fiber optic cables) Innerduct shall be circular and of uniform cross-section to the dimensions in accordance with ASTM D3035. Innerduct shall be a continuous length of smooth in/ribbed out with a low friction internal surface containing no welds or joints, coiled on a reel. Innerduct shall be supplied containing a pulling medium such as tape or rope (minimum pull tension rating of 1200 pounds). Innerduct shall be extruded from new high-density polyethylene (HDPE) resin, in accordance to the requirements of ASTM D3350 Type III. Density, melt flow, tensile strength at yield and environmental stress crack shall conform to the values listed ASTM D3350. Adequate stabilization shall be added during the manufacturing process to protect the polyethylene against thermal and UV degradation throughout the projected lifespan of the finished product. The colors shall be orange, white, black and Blue.

2. Manufactures:

   a. Carlon, or equal

D. Miscellaneous Components

1. Backbone Interbuilding Fiber Optic Cable Labels. Machine printable labels with a thermal transfer printer. Labels shall fit the backbone fiber cables listed above (i.e., shall fully wrap around the cable's jacket). A minimum 2" x 0.5" printable area, in size, and white in color.

   a. Manufacturer:
      1. Panduit or equal

         1. #RMR4BL; thermal transfer ribbon, black
         2. #M300X100Y7T; thermal transfer marker plate, 3"L x 1"W, white b. Or equal.

2. Fiber Slack Storage Reel
   a. Manufacturer:
      1. Leviton or equal

         1. #48900-OFR

3. Velcro Cable Ties

   a. Width: .75". Color: Velcro cable ties, same color as the cable to which it is being applied.
   b. Manufacturers:

1. Panduit or equal

    1. #HLS-15R-0 Black, 15’ roll, cut to length

2.58 INSTALLATION

A. Backbone Cable

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere, unless approved in writing by the Engineer prior to installation. Protect fibers during installation & termination. Fibers damaged beyond repair during installation or termination shall result in replacement of the affected cable at no additional cost.

B. Placement

1. Bend Radius: Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.
2. Pulling: Maintain pulling tension within manufacturer's limits. Use a pulling tension meter when using mechanical assistance during installation. Record maximum pulling tension for each cable run and submit to the Engineer for review if requested. Replace runs when manufacturer’s maximum pulling tension is exceeded.

C. Protection:

1. Place and suspend cables in a manner to protect them from physical interference or damage. Replace cable if damaged during installation. Place cables with no kinks, twists, or impact damage to the sheath. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions. Provide a 30 feet (minimum) sheathed cable slack loop at each end of the run within the Telecommunication Rooms; store slack in fiber slack storage reel mounted on the wall. Provide a 30 feet (minimum) sheathed cable slack loop within each underground communications vault; store slack in racking mounted on the vault walls. Place a pull rope along with cables where a conduit has spare capacity for future cabling. Tie off ends of the pull rope.

D. Routing

1. Route cables in innerduct between points of termination throughout entire length (except at the fiber take up reel). Install cables within designated pathways according to the drawings. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via tie wraps or Velcro-type straps. When routing horizontally within telecom rooms, utilize the overhead cable tray. When routing vertically within telecom rooms, utilize the wall mounted vertical cable runway and properly fasten. “Properly fasten” shall consist of cable ties in a ‘crossed’ configuration per cable or cable bundle (up to three cables or innerducts) every 24 inches on center. Place and suspend cables in a manner to protect them from physical interference or damage. Provide 30 feet (minimum) sheathed cable slack loop at each end of the run within the Communications

Rooms and in each manhole along the entire run between the building and the CEV. Support slack loop on wall using Velcro slack management spool in the Communication Rooms. Support slack loop on racking in manhole. If racking does not exist. Provide small support rack on the interior wall of the telecom vault.

E. Termination

1. Properly strain relieve cables at termination points (at/within the fiber optic termination panels) per manufacturer's instructions.

2. Terminate/connectorize fiber strands at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform terminations in accordance with manufacturer's instructions.

3. Provide required tools, consumables and accessories for complete termination of fiber strands.

4. Provide 3 feet of unsheathed fiber slack within the patch panel/termination shelf at each end of the runs. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions or guidelines. Include 'extension' slack loop/fold in the rear of the shelf to allow for the drawer to be pulled out without putting tension on the fibers.

F. Fiber Optic Cable Termination

Provide the termination panel in designated equipment rack for each building's telecommunication room if not existing. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.

2.59 OUTSIDE PLANT INNERDUCT

A. All outside plant fiber optic cables shall be placed within outside plant innerduct.

B. If innerduct does not exist, provide (4) 1-inch innerducts in vacant 4-inch conduit over the entire cable run from Communication Room to Communication Room or CV to CV. It is not permissible for one innerduct to be pulled through a 4" conduit. Each innerduct shall have a unique color. Innerducts of a different color shall be placed within each run of conduit. It is not permissible for two innerducts within the same conduit to be the same color. Colors are white, orange, black, and Blue for four 1-inch innerducts within one 4inch conduit. Break innerduct at each telecommunication vault just past the conduit stub in locations to allow for fiber optic cable service loops. Secure innerduct at each telecommunications vault and entrance facility with quadplex duct plugs. Secure each fiber optic cable within innerduct at each telecommunications vault, and the Communications Room with a fiber optic simplex plug sized depending upon the outside diameter of the cable. All unused innerducts shall be plugged with blank innerducts plugs at all telecom vaults and entrance facility room stub out locations.

2.60 LABELING

A. Labeling and identifier assignment shall conform to the TIA/EIA-606 Administration Standard and as approved by the Owner or Owner's Representative before installation. Label colors shall conform to the TIA/EIA-606 Administration Standard. Permanent machine-generated labels, (hand written labels will not be accepted).

B. Label Formats

1. Cable Labels Black text, minimum 1/8" high, or #12 font size. Provide labels on both ends of cables. Install labels no more than 4" from the edge of the cable jacket. Fully wrap label around the cable jacket. Install labels such that they are visible by a technician from a normal stance. Termination Apparatus Labels Either labels are included in the product packaging, or fully compatible, in the opinion of the Engineer, with the block system. Provide brown label respective field type, per TIA/EIA-606. Black text, minimum 3/32" high, or #10 font size.

C. Identifier Assignment

1. Separate all label fields of the identifier with a hyphen. Backbone OSP Fiber Optic Cables Coordinate all labeling of fiber with Jay Kim IST-IS. Termination Positions at the Termination Panels Make the first field the FIC number; for example, "FIC xxx" Make the second field the Cable number; for example, "Cable #xxx" Make the third field the identifier of the origin room; for example "B900" Make the fourth field the identifier of the destination room; for example "M70" Make the fifth field the identifier of the fiber count and type; for example, "24-MM" Identifier Example: "FIC001-001-B900-M70-24-MM".

D. Final Inspection

1. Inspect installed products and work in conjunction with the Owner or Owner's Representative. Develop a punchlist for items needing correction.
2. Issue punchlist to Engineer for review prior to performing punchlist with the Engineer.
3. Repair defects prior to system acceptance.
4. Inspect installed products and work in conjunction with the Engineer for sign off.

2.61 COMMUNICATIONS BONDING AND GROUNDING

A. Bonding and Grounding References

1. NFPA 70, "National Electrical Code":
    1. Article 250: Grounding
    2. Article 770: Optical Fiber Cables and Raceways
    3. Article 800: Communications Systems
2. Underwriters Laboratories, Inc. (UL) UL 467: Grounding and Bonding Equipment
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 467: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
2. IEEE P1100: IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems

B. Bonding and Grounding Definitions

1. Define the following list of terms, as used in this specification, as follows:
   a. "CM": Circular Mil.
   b. "MBRGB": Main Building Reference Grounding Busbar.
   c. "TBB": Telecommunications Bonding Backbone.
   d. "TBC": Telecommunications Bonding Conductor.
   e. "TGB": Telecommunication Grounding Busbar.
   f. "TMGB": Telecommunication Main Grounding Busbar.

C. Products shall be UL listed for their purpose and installation.

2.62 GROUNDING AND BONDING CONDUCTORS

A. Suitable for indoor installation as a BCT, TBB, GE, and/or TBC.
1. Type: THHN (or THWN)
2. Conductor: 1/C, annealed copper, stranded
3. Gauge: Refer to System Description for conductor sizing criteria.
4. Insulation: thermoplastic/nylon or similar, green in color
5. Flame Resistance: Meet the flame resistance requirements of IEEE 383, CSA FT-4 and UL VW-1.
6. Cable shall have printed on its insulation/jacket, the insulation grade, the conductor gauge, and applicable UL jacket listings.

B. Grounding Busbars

1. Solid copper. Holes: Predrilled, compatible with standard NEMA bolt hole sizing and spacing and with ANSIJ-607-A recommendations for 2-hole lugs. Mounting: Wall-mounted with standoffs. Standoffs shall insulate busbar from the mounting surface. Standards: Compliant to ANSI-J-607-A

2. Manufacturer, or equal:
   a. Chatsworth Products Inc #13622-012; busbar, 12"L x 2"W x ¼"T, TGB hole pattern
   b. Chatsworth Products Inc #40153-012; busbar, 12"L x 4"W x ¼"T, TMGB hole pattern

C. Vertical Rack Busbar

1. Material: Copper Alloy Holes: Predrilled for ¼" – 20 hardware Mounting: Rack-mounted with standoffs. Standoffs shall insulate busbar from the mounting surface.

2. Manufacturer, or equal:
   a. Chatsworth Products Inc #40161-072; vertical rack busbar kit, 72"L x 5/8"W x ¼"T

D. Tap

1. TBB-to-TBC permanent connection
2. Manufacturers:
   a. Panduit or equal
      1. #HTCT2-2-1; “H-type” compression tap, run = #6-#2, tap = #2-#6.
      2. #HTCT250-2-1; “H-type” compression tap, run = #2-250MCM, tap = #6-#2.

E. Compression Lug

1. Conductor-to-busbar and/or –rack (or other flat surfaces) connection Type: compression lug, standard or long barrel, two-hole (1/4 inch diameter 5/8 inch on center)
2. Manufacturer:
   a. Panduit or equal
      1. #LCC2/0-14AW-X; for 2/0 AWG conductor
   b. Thomas & Betts or equal
      1. #54205

F. Connector/Split-Bolt, Mechanical Type

1. Conductor-to-conductor (or other round component) connection. Type: split-bolt mechanical connector, for #6 to #3 conductor. Material: high-strength copper alloy

2. Manufacturer:
   a. Panduit or equal
      1. #SBC3-C

G. Bonding Conductors

1. TBC Conductor: #6 AWG (up to 25 feet) stranded copper. Insulation: Low-smoke, green in color. Print the following on the conductor’s jacket: insulation grade, conductor gauge, and applicable UL jacket listings. Type THHN, or approved similar.

H. Cable Tray Bonding Jumper

1. Suitable for bonding two sections of cable tray.
2. Manufacturer:
   a. Cooper B-Line or equal
      1. #99-30

I. Connectors

1. General: Provide UL Listed Connectors. TBC-To-TGB/TMGB. Lug, two-hole standard barrel compression lug.
2. Manufacturer: Panduit or equal
      1. #LCD6-14A-L; two hole (1/4” dia. x 5/8” on center) standard barrel lug for #6 AWG conductor.

J. Miscellaneous

1. Metallic Armored Fiber Optic Cable Grounding Clamp
   a. Manufacturer: Commscope
      1. #12A1 Clamp; clamp for metallic sheath cable

2. Wire Clamp

   a. Material: nylon, UV stabilized. Color: black Size: 0.25" holding diameter for 6 AWG; or size as required based on conductor size.

   b. Manufacturer: Richco Inc. or equal
      1. #N4B-BLK; clamp for 6 AWG

3. Paint Piercing Grounding Washer Kit Color: black Size: 3/8" or M8 stud size, 0.875" outside diameter
   a. Manufacturer: Panduit or equal
      1. #RGW-100-1Y

K. Prior to the start of this Section's work, examine Telecommunications Grounding Backbone system. Prior to the start of this Section's work, ensure work of this Section is fully compatible, in the opinion of the Engineer, with the Telecommunications Grounding Backbone system.

2.63 BONDING AND GROUNDING INSTALLATION

A. When routing a TBB conductor through metallic conduit 3 feet or longer, bond both ends of conduit to the grounding conductor using a #6 AWG bonding conductor, irreversible connection (preferably exothermic weld), and insulated ground bushings. Bond communications conduit, cable tray, cable runway, equipment racks, and other metallic telecommunication infrastructure components to the nearest TMGB using a TBC and appropriate grounding hardware. Install grounding conductors in conduit to protect them from physical damage where appropriate.

B. TBB

1. Size: Refer to drawings for conductor size. If not shown, size TBB conductors based on length of run using 1000 circular mil per linear foot, up to 2/0 AWG. Install TBB(s) in a manner that will protect them from physical and mechanical damage. Install the TBB without splices. In the event that a splice is necessary, notify the Engineer in writing. Do not proceed with work on the TBB until the Engineer has responded in writing accepting the installation of a splice. Locate the splice in a telecommunications space and ensure accessibility. Perform the splice using an exothermic weld or an irreversible compression-type connector. Install TBBs within designated pathway (e.g., conduit). Where shown on the Drawings, connect grounding conductors to structural steel using exothermic welds. Each particular type of weld shall use a kit unique to that type of weld.

C. TMGB and TGB Busbars

1. Mount busbars as noted on Drawings and using insulating standoffs. If not noted on Drawings, install busbars onto wall at minimum 90 inches AFF located within 5 feet of

entrance into room. Thoroughly clean busbars prior to fastening the conductors, bolts, or connectors to the bus bar. Attach lugs to bus with appropriate size cadmium bronze bolt, flat washer and Belleville washer. Torque hardware at connections.

D. Vertical Rack Busbar Kits

1. Mount busbars as noted on Drawings, using insulating standoffs and all accessories included within the kit. If not noted on Drawings, install busbars at the right rear of each equipment rack. Thoroughly clean busbars prior to fastening the conductors, bolts, or connectors to the busbar. Attach lugs to bus with appropriate size cadmium bronze bolt, flat washer and Belleville washer. Torque hardware at connections.

E. Armored Fiber Optic Cable Grounding Clamp

1. Install grounding clamp per manufacturer's installation instructions. Provide grounding clamp at each end of each armored fiber optic cable segment.
2. TBC:

3. Use bonding jumpers, up to 25 feet long, for bonding equipment and other metallic components within a Telecommunications Room to the grounding busbar. Provide continuous bonding conductors routed in the shortest possible path, using right angles for turns and routed parallel to building lines and not in center of backboards. Utilize a minimum 1foot bend radius for conductors.

2.64 COMMUNICATIONS HORIZONTAL CABLING

A. Definitions

1. "CAT5E": Category 5 Enhanced [UTP] performance grade
2. "CAT6A": Category 6 Augmented [F/UTP] performance grade
3. "Channel": End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.
4. "CMP": Communications Media Plenum [NEC plenum rating]
5. "CMR": Communications Media Riser [NEC riser {non-plenum} rating]
6. "FEP": Fluorinated Ethylene Propylene
7. "F/UTP" or "FTP": Foiled Twisted Pair
8. "PE": Polyethylene
9. "Permanent Link": Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the 'permanent' portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used), termination/connecting apparatus in the IDFs and the connector at the outlet.
10. "PVC": PolyVinyl Chloride
11. "U/FTP": See "F/UTP"
12. "UTP": Unshielded Twisted Pair

B. Manufacturers

1. Product for horizontal cabling system shall be by Siemon. No substitutions unless otherwise noted.
2. Products for termination equipment shall be by Siemon, or equal as noted. No substitutions allowed unless otherwise noted.

2.65 HORIZONTAL CABLE – OSP/UNDERGROUNd

A. CAT5E UTP 4-Pair Cable (OSP RATED)

B. Provide cable suitable for outdoor installations, within underground conduit.

C. Conductors:

1. Insulated Conductors: 24 AWG solid copper, fully insulated with a thermoplastic material (material = PE, or equivalent). Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair), and individually color-coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230).

D. Core & Sheath:

1. Twisted pairs shall lie individually within a polyolefin fluted center member. Filled: Provide cable core and sheath flooded with filling compound to protect against moisture penetration. Filling compound: gel, or equivalent. Jacket: PE, black. Electrical Performance: Meet or exceed TIA/EIA-568-B.2-1 and ISO/IEC 11801 requirements for CAT5E UTP cabling.

2. Manufacturer:
   a. Belden or equal
   b. 7997A, 4 pair 24AWG, OSP cable, or equal by manufacturer listed in 2.2

2.66 HORIZONTAL CATEGORY 5E UTP STATION CABLE (CMP RATED)

A. Cable shall be suitable for indoor installation, in an air-plenum environment. Each and every cable run shall be a continuous single cable, homogenous in nature. Splices are not permitted. The cable shall contain four twisted pairs. Each twisted pair shall consist of two conductors insulated with a flame retardant thermoplastic material. All twisted pairs shall be individually color coded to industry standards (ANSI/ICEA Publication S-80-576, and EIA-230). All conductors shall be 24 AWG solid copper. The cable sheath shall be unshielded, and shall be covered with a seamless overall outer jacket consisting of a flame-retardant material, such as low-smoke polyvinyl chloride (LS-PVC). The cable shall be NEC rated as CMP, and UL listed as such. The electrical performance of the overall cable & twisted pairs shall comply with ANSI/TIA/EIA568-A. Requirements for Category 5e UTP cabling. Cabling shall have foot markers the entire length of the cable space one foot on center maximum. Cable jacket colors: Voice – white Data – blue

B. Manufacturer:
   1. Siemon
      a. #9C5P4-E1-02-RXA; CAT5e 4 pair 24AWG, UTP, CMP cable, white

b. #9C5P4-E1-06-RXA; CAT5e 4 pair 24AWG, UTP, CMP cable, blue

2.67 Horizontal Cable – CAT6A Plenum (CMP) Rated

A. Suitable for indoor installation, within ceiling space in primary and secondary pathways, within access/raised floor space.

B. Conductors:
1. Insulated Conductors: 23 AWG solid copper, fully insulated with a flame retardant thermoplastic material (material = FEP, or equivalent). Twisted Pairs: Two insulated conductors "twisted" into a "pair" (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80576-1994, and EIA-230).

C. Cable Sheath:

1. Outer Jacket: seamless outer jacket (material = LS-PVC, or similar) applied to and completely cover the internal components (twisted pairs). Shield: single overall aluminum/poly with tinned copper drain wire.

2. Flame Rating: NEC (Article 800) rated as CMP, and UL listed as such. Electrical Performance: Meet or exceed TIA/EIA-568-C.2, ISO 11801 Class E Edition 2.1, and IEEE Std. 802.3an channel requirements for supporting 10GBASE-T.

3. Manufacturer:
a. Siemon
1. #9A6P4-A5-06-R1A; CAT6A 4 pair F/UTP cable, "Z-MAX", shielded, CMP – Blue
2. No substitutions

D. 110 Termination Blocks

1. Horizontal Cabling Termination Blocks, In Telecom Rooms

2. Termination blocks shall be suitable for installation within a telecommunication facility for the termination of the station cables. Each termination block shall be 110 type, trough-mounted, and have a 900 pair / 216 horizontal cable capacity. The blocks shall be vertically oriented for a wall mounted column configuration. All termination blocks shall be accompanied by the appropriate quantity of management 'backboards', for both horizontal and vertical routing of cross connect wiring.

3. Manufacturer:
a. Panduit or equal
1. #P110KT9004Y, 900 Pair 110 Punchdown Tower Kit, 4 Pair Connectors
2. #P110VCM900, Vertical management 'backboard'

E. Termination Apparatus – Discrete Port Panel (Data Only)

1. Discrete port patch panels shall be suitable for installation within a telecommunication room (BDF/IDF) for the termination of the Category 5e Horizontal Data Cables specified herein. Discrete patch panels shall be horizontally oriented for a rack-mounted

configuration. Discrete patch panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and network equipment or the equipment termination field. Discrete patch panels shall support 48-ports. Each port shall accept one modular connector (8-position modular jack).

2. Manufacturer:
   a. Siemon
      1. #HD5-48; CAT5e discrete patch panel "HD5", 48 ports, 2U
   b. No substitutions

F. Termination Apparatus – Discrete Port Panel (CAT6A Only)

1. Discrete port patch panels shall be suitable for installation within a telecommunication room (BDF/IDF) for the termination of the Category 6A Horizontal Cables specified herein. Discrete patch panels shall be horizontally oriented for a rack-mounted configuration. Discrete patch panels shall be capable of supporting, organizing, labeling and patching/crossconnecting between the horizontal termination field and network equipment or the equipment termination field. Discrete patch panels shall support 24-ports. Discrete patch panels shall be fully metallic and suitable for shielded modular connectors. Each port shall accept one shielded modular connector (8-position modular jack).

2. Manufacturer:
   a. Siemon
      1. #Z6AS-PNL(X)-24K; CAT6A discrete shielded patch panel "Z-MAX", 24 ports, 1U, black
   b. No substitutions

G. Modular Connector – CAT 5E Rated

1. Modular Connectors, at Outlets

2. All Horizontal station cables shall be terminated via 8 position modular connectors. Each connector shall be Category 5e rated. All jacks shall be T568A wired.

3. Manufacturer:
   a. Siemon
      1. #MX5-02; CAT5e "MAX" connector, angled, white (Voice)
      2. #MX5-06; CAT5e "MAX" connector, angled, blue (Data)

H. Modular Connector – CAT6A Rated

1. Modular connectors (jacks) for termination of 4-pair F/UTP cables; modular connectors shall be compatible with the 4-pair cables specified herein this section both electrically and physically.

2. Mechanical Performance: Modular jacks shall be 8-position, compliant to ANSI/TIA-568-C.2.

3. Electrical Performance: Each jack shall meet or exceed TIA/EIA-568-C.2 and ISO/IEC 11801 requirements for CAT6A F/UTP cabling.

4. Wiring: Modular connectors shall be T568A wired.

5. Manufacturer:
   a. Siemon
      1. #Z6A-S05; CAT6A 8-position jack, shielded "Z-MAX" jack, hybrid flat/angled, yellow

I. Workstation Outlets

1. Flush Mount Outlets – Standard Faceplates Standard workstation faceplates shall have 4 ports.
2. Faceplates shall include all required accessories, such as, blank inserts, labels and label windows
3. Standard faceplates shall be compatible with both the UTP CAT5e and F/UTP CAT6A modular jacks used to terminate horizontal cabling. Color: White.

4. Manufacturer: Siemon
   a. #MX-BL-02; blank module, "10G MAX", white
   b. #10GMX-FPS04-02; four port "10G MAX" modular faceplate, white

J. Flush Mount Outlets – Standard Wall Phone Faceplates

1. Wall phone faceplates shall come equipped with 1 modular jack and two mounting studs. Color: Stainless Steel.

2. Manufacturer:
   a. Siemon
      1. #MX-WP-K5-SS; wall phone faceplate with CAT5e module

2.68 LABELS

A. Horizontal Cables

1. Labels shall be self-laminating, and shall be machine printable with a laser printer.
2. Printable Area: 2" x .5". Cable Size: 0.16 – 0.32" OD. Color: white.

3. Manufacturer:

   a. Panduit or equal
      1. #PLL-40-Y3-1, white, 1000 labels

B. Miscellaneous Components

1. Velcro Cable Ties – For use in telecom rooms and spaces only Provide Velcro cable ties.
2. Width: .75". Provide a minimum 2" overlap on all ties.

3. Manufacturers:
   a. Panduit or equal
      1. #HLS-15R-6 Blue, 15’ roll, cut to length.

C. Plenum Tie Wraps – For use in user spaces only Plenum rated. Suitable for installation within plenum spaces. Length: 12” Width: 0.35" Flammability: UL94 class HB

1. Manufacturer:
   a. Millepede
      1. #UL1565, plenum mille-ties

2.69 WLAN REQUIREMENTS

A. Provide Wireless Access Point (WAP), wireless management, controller devices and software to perform continuous automatic active tuning of the wireless environment throughout the entire facility.

B. Provide system wide support for IEEE 802.11b/g/n at 2.4 GHz and 802.11a/n/ac at 5 GHz.

C. Provide support for WPA and WPA2 encryption.

D. 802.11n access points. This provides the necessary foundation for enterprise and service provider networks alike to stay ahead of the performance and bandwidth expectations and needs of their wireless users.

E. Due to its convenience, wireless access is increasingly the preferred form of network connectivity for corporate users. Along with this shift, there is an expectation that wireless should not slow down user’s day-to-day work, but should enable a high-performance experience while allowing users to move freely around the corporate environment.

F. By Utilizing a Purpose-built Innovative Chipset with the Best-in-class RF Architecture for a High Density Experience (HD Experience).

2.70 INSTALLATION

A. Firestopping

1. Fire stop all penetrations through fire rated structures as a result of telecom work using EZ-Path devices.
2. All penetrations through fire rated structures shall be properly fire stopped according to state and local codes to maintain the fire rating of the penetration.

B. Horizontal Cabling
1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.

2. Maintain pulling tension within manufacturer's limits. Protect cable during installation. Replace cable if damaged during installation. Place cables with no kinks, twists, or impact damage to the sheath.
3. Place a pull string along with cables where run in conduit. Tie off end of pull string in ceiling spaces to prevent the string from falling into the conduit.

C. Routing
1. Maintain maximum cable length of 90 meters from the termination in the IDF to the termination at the user's faceplate. When routing horizontally within telecom rooms, utilize the overhead level-3 cable runway (in BDF only). When routing vertically within telecom rooms, utilize the wall mounted vertical cable runway and support every 24 inches on center using approved Velcro ties. Place and suspend cables in a manner to protect them from physical interference or damage. Route cables a minimum of 6" away from power sources to reduce interference from EMI. When routing cables in areas without cable tray/runway, support cables utilizing J-hangers. Do not route these cables under building infrastructure such as ducts, pipes, conduits, etc to provide cable accessibility in the future. Do not route cables over building infrastructure (HVAC, water pipes, lights, etc.). Do not tie cables to building infrastructure components such as, pipes, ducts, support wire and rods, conduits, wall studs, etc.
2. Route station cable homeruns at 90-degree angles, allowing for bending radius, along corridors for ease of access. Do not route through an adjacent space if a corridor borders at least one wall of the room.
3. Provide a 10 feet (minimum) sheathed cable slack loop at the end of the run within the user space. Place the slack loop in ceiling space supported from a J-hanger adjacent to the device feed conduit stub-out. Fasten the bottom of the slack loop using an approved cable tie. Provide six inches (minimum) of sheathed cable slack behind each workstation outlet faceplate. Coil the slack cable inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer's installation standards.
4. When exiting the cable tray in the user space, exit via the top of the tray. Secure the cables to the cable tray using an approved cable tie (Velcro only).

D. Termination – CAT5e Voice Cabling
1. Horizontal CAT5e cabling (voice only) terminates on wall mounted 110 blocks. Terminate horizontal cables in room number sequence, and then by cable sequence number by room. Properly strain-relieve cables at termination points per manufacturer's instructions. Terminate copper pairs at both ends on the specified connecting hardware. Perform terminations in accordance with manufacturer's instructions and TIA/EIA568-B standard installation practices. Install modular connectors in an angled orientation at the outlet faceplate.

E. Termination – CAT5e Data Cabling
1. Horizontal CAT5e cabling (data) terminates on rack mounted patch panels. Terminate horizontal cables in room number sequence, and then by cable sequence number by room. Properly strain-relieve cables at termination points per manufacturer's instructions. Terminate copper pairs at both ends on the specified connecting hardware. Perform terminations in accordance with manufacturer's instructions and TIA/EIA568-B standard installation practices. Install modular connectors in an angled orientation at the outlet faceplate.

F. Termination – CAT6A Data Cabling
   1. Horizontal CAT6A cabling (data) terminates on rack mounted patch panels. Terminate horizontal cables in room number sequence, and then by cable sequence number by room. Properly strain-relieve cables at termination points per manufacturer's instructions. Terminate copper pairs at both ends on the specified connecting hardware. Ground all shielded rack-mounted patch panels to the vertical rack busbar.
   2. Perform terminations in accordance with manufacturer's instructions and TIA/EIA568-B standard installation practices. Install modular connectors in an angled orientation at the outlet faceplate.

G. Telecommunication Equipment Grounding
   1. Ground all metallic telecommunication equipment to the TMGB and TGB within the telecom rooms.
   2. Ground all shielded rack-mounted patch panels to the vertical rack busbar.

2.71 RECORDS

A. Labeling
   1. The contractor shall be responsible for the physical labeling of all of the communication system components in complete conformance with TIA/EIA-606 Administration Standards. The components shall include, but are not limited to, the following:
      a. Cables (both ends)
      b. 110 termination blocks
      c. Patch Panels
      d. Outlets

2.72 SECURITY AND SURVELLANCE

A. Security System References

   1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.
   2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title, or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
   3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

   1. United States Department of Labor (DOL) Regulations (Standards - 29 CFR)

a. Part 1910: Occupational Safety and Health Standards
2. National Fire Protection Agency (NFPA)
a. NFPA 70: National Electrical Code (NEC)
b. NFPA 75: Protection of Information Technology Equipment
3. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC)
4. California Building Code (CBC)
5. California Fire Code (CFC)
6. California Mechanical Code (CMC)
7. National, State, Local and other binding building and fire codes
8. FCC Regulations:
a. Part 15: Radio Frequency Devices & Radiation Limits
b. Part 68: Connection of Terminal Equipment to the Telephone Network

C. Standards: Perform Work and furnish materials and equipment under Division 28 in accordance with the latest editions of the following standards as applicable:

1. Underwriters Laboratories (UL): Applicable listing and ratings.
a. UL 294: Access Control System Units
b. UL 1076: Proprietary Burglar Alarm Units and Systems
c. UL 60950: Information Technology Equipment
d. UL 2044 Commercial Closed-Circuit Television Equipment

2.73 SCOPE OF WORK

A. Access Control and Alarm Monitoring System (ACAMS). The Owner requires an access control system to automate opening and closing of the building, restrict access after hours by cardholder privileges, and monitor specific spaces for intrusion. The ACAMS consists of card readers, control panels, power supplies, workstations, alarm monitoring devices, and interfaces to other security equipment.

B. The IDS consists of keypads, control panels, and interfaces to the ACAMS. The IDS will communicate with the existing alarm receiver located in the Security Room for backup alarm monitoring and dispatch of security personnel.

2.74 VIDEO SURVEILLANCE SYSTEM (VSS)

A. The Owner requires a video surveillance to provide real-time monitoring of the facility, a photographic record of access control transactions and alarm events, and integration with the entry telephone system.
B. The VSS consists of a combination of IP and analog cameras, power supplies, encoders, and network video recorders.

2.75 QUALITY ASSURANCE

A. Contractor Qualifications

1. A current, active, and valid Contractors License. Certification letters stating the Contractor is an authorized reseller, installer, and extended warranty provider for the following systems:
    a. Software House, “Advanced Integrator” certification level

2. Minimcut defects and of current manufacturer, materials. Use specified products and applications, unless otherwise submitted and approved in writing.

2.76 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner. Store materials in a clean, dry, ventilated space free from temperature extremes. dirt, water, construction debris, and traffic. Provide heat where required to prevent condensation or temperature related damage. Handle in accordance with manufacturer's written instructions. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

2.77 WARRANTY

A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to the Owner. Include in the warranty package, at a minimum, the following:

1. Software upgrade plan Labor to install software upgrades and patches necessary to maintain the latest version Emergency service on regular working hour basis Service by factory trained and employed service representatives of system manufacturer. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twentyfour (24) hours after notification of a malfunction, at no additional cost.
2. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

2.78 SUBSTITUTIONS

A. Only one substitution allowed for each product specified. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data –required to substantiate that the product is in fact equivalent to that specified. The burden of proof rest with the Contractor that the substituted product is equivalent to the specified product. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance.

Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s). When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

2.79 INSTALLATION

A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified. Manufacturer's Instructions:

B. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite. Boxes, Panels, and Enclosures

C. Install boxes, panels, and enclosures square and plumb. Set "flush mounted" units with the face of the cover, bezel or escutcheon in the same plane as the surrounding finished surface.

D. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.

E. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

2.80 REPAIR/RESTORATION

A. Replace or repair work completed by others that you deface or destroy, at no cost to the Owner.

2.81 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage. Repair or replace damaged installed products. Legally dispose of debris. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

2.82 SECURITY SYSTEM CABLING

A. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and video signal cable in the same conduit without interference or signal noise. Cable installed outdoors or in underground conduit

must contain a PVC or Polyethylene jacket to prevent water intrusion and compliant with the TIA-455-82B water infiltration test. Cables installed indoors to contain a white plenum rated jacket (type CMP).

B. Manufacturers:
    1. West Penn or equal

2.83 ACCESS CONTROL & ALARM MONITORING SYSTEM

A. Plenum Jacketed Cable
    a. #18/2 AWG unshielded: West Penn #25224B, door contact cable
    b. #18/4 AWG unshielded: West Penn #25244B, REX and alarm device cable
    c. #18/6 AWG shielded (overall): West Penn #253186B, card reader cable
    d. #16/2 AWG unshielded: West Penn #25225B, lock power cable
    e. #14/2 AWG unshielded: West Penn #25226B, lock power cable from local power booster to exit device

2.84 VIDEO SURVEILLANCE SYSTEM

A. Cabling for IP cameras provided by Telecommunications contractor.

2.85 INTRUSION DETECTION SYSTEM

A. Plenum Jacketed Cable
    a. #22/2 AWG unshielded: West Penn #25221B, door contact cable
    b. #22/4 AWG unshielded: West Penn #25241B, keypad and alarm device cable
    c. #18/2 AWG unshielded: West Penn #25224B, control panel power cable

B. Miscellaneous Components

C. Cable Ties
    1. General
        a. Provide Velco-style cable ties on security cabling within telecommunications spaces and covered wireways.
        b. Dress and bind cabling with cable ties every 24” minimum.
        c. Width: 0.75 inches
        d. Color: Black
    2. Manufacturer: Panduit or equal
        a. #HLS-15-R-0 Black, 15 feet roll, cut to length

2.86 HORIZONTAL CABLE INSTALLATION AND ROUTING

A. Provide wire and cable with a continuous, splice-free sheath for the entire length of run between designated connections or terminations. Splices not permitted. Place cables within designated pathways, such as cable tray, basketway, cable hangers, etc. Do no fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged

during installation or termination at no additional cost. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access. Do not exceed manufacturer's limits for pulling tension. Do not use cable-pulling compounds for indoor installations. Route cables under building infrastructure (such as ducts, pipes, conduits, etc) so the installation results in easy accessibility to the cables in the future. Do not route cables over building infrastructure. Dress and secure coaxial cables to preclude stress and/or deformation. Install shielded wiring or route in separate raceways as recommended by the manufacturer's current requirements. Place cables 6", minimum, away from power sources to reduce interference from EMI. Do not run signal wire and cable in parallel to power (120VAC). Make connections to screw-type barrier blocks with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections. Follow manufacturers recommended guidelines for installation. When exiting the primary pathway (such as basketway or cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

2.87 CABLE ROUTING AND DRESSING WITHIN TELECOMMUNICATION ROOMS

A. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties. Only use Velcro type cable ties within the IDF. Neatly bundle (dress cable longitudinally) and support security cables within overhead cable runways. Dress and bind cabling with cable ties every 12” minimum. Provide 4 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within the screw cover gutter wireways.

2.88 CABLE SUPPORT

A. Horizontal Support

1. Provide separate and dedicated cable support system for security cable runs. Anchor cable support system to structural ceiling. Support and tie cables at a maximum of 5-foot intervals.

B. Vertical Support

1. Riser Systems
   a. Route cable through conduit in vertical riser systems. Terminate conduit at each stacked closet in a lockable junction box. Fastened entire cable group to the inside of junction box at every other floor or approximately every 24 feet. Fasten cable in Junction box utilizing cable ties equipped with eyelets designed to accept screws for fastening or approved equivalent method. Vertical cable on floor space not in riser system. Route cable from below suspended ceiling devices to above ceiling when possible. Provide conduit and firestopping for cable routed in fire rated wall assemblies. Provide conduit for cable routed from below ceiling devices to above ceiling on concrete tilt up style walls. Cable routed vertically from devices with no suspended ceiling. Provide conduit stub from device junction box to 14 feet above

2.89 SECURITY SYSTEM LABELING

A. Nameplates

1. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

B. Labels

1. Wire and Cable Labels:
   a. Self-laminating adhesive laser labels
   b. Machine printable with a laser printer
   c. Cable size: 0.16 – 0.32" OD
   d. Color: white with black lettering
2. Manufacturer:
   a. Brady #WML–211-295 and #WML-311-292 wire marking labels
   b. Or Equal
3. Device Labels:
   a. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

C. Installation

1. Label the security system components. The components include, but are not limited to, the following:
   a. Equipment Enclosures
   b. Conduits
   c. Security Devices
   d. Batteries
   e. Wires and Cables
   f. Equipment Racks
   g. Terminal Blocks
   h. Relays
   i. Patch panels, and the termination positions within the patch panels.

2. Labels to coincide with device IDs used on the record drawings. Degrease and clean surfaces to receive nameplates and labels Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

2.90 EQUIPMENT CABINETS

A. Label SEC enclosures associated with the security system with a nameplate. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.

B. Example: Line 1: "SEC-01" (1/2 inch high letters) Line 2: "Security Equipment Cabinet" (1/4 inch high letters)

2.91 Conduits

A. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.
B. Example: “To SEC-01”

2.92 Security Devices

A. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12-point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.
B. Label each device in a concealed location with the system point number and address.

2.93 Batteries

A. Label power supply batteries with the month and year they were installed.
B. Example: “December 2012”

2.94 Wire and Cable

A. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.
B. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.
C. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same-labeled designation over its entire run, regardless of intermediate terminations.
D. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.
E. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.
F. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

2.95 Cable Label Format

A. From Panel to Field Device
    1. Line 1: Device Type and Device Number
    2. Line 2: Panel ID – Port Number
    3. Example: CR 001 PANEL 2 – CR5
    4. Standard Device Types
        a. CR = Card Reader
        b. K = Camera
        c. ET = Entry Telephone
        d. R = Relay Output
        e. A = Alarm Point
    5. Standard Port #s
        a. CR = Reader
        b. M = Monitored Input
        c. R = Relay Output

B. From Door Junction Box to Card Reader
   1. Line 1: Device Type and Device Number
   2. Line 2: Panel ID – Port Number
   3. Example: CR 001 PANEL 4 – CR3
   4. Miscellaneous Examples:
   5. From Door Junction Box to Door Contact
      a. CR001
      b. DC
   6. From Door Junction Box to Rex Alarm
      a. CR001
      b. REX ALM
   7. From Panel to Rex
      a. CR001
      b. REX PWR
      c. 12 VDC
   8. From Panel to Lock
      a. CR001
      b. LCK PWR
      c. 24 VDC

2.96 SECURITY SYSTEM ACCEPTANCE TESTING

A. Overview

   1. The purpose of acceptance testing is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation. Perform testing activities after-hours or on weekends when the system is "quiet" and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.

B. Pre-Test

   1. Perform a 100% pre-test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system's operation to the Owner and Engineer. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports.

C. Final Test

   1. Perform a final test of the system in the presence of the Point 1 and Owner representatives to demonstrate correct operation of the security system.

D. Submittals

   1. Operation and Maintenance Manuals: Submit the following for review and comment at the completion of the project:

      a. Functional Design Manual: Includes a detailed explanation of the operation of the

system.

b. Hardware Manual which includes:

1. Pictorial parts list and part numbers
2. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators
3. Telephone numbers for the authorized parts and service distributors
4. Include service bulletins

c. Software Manual which includes:

1. Use of system and applications software
2. Initialization, start-up, and shut down procedures
3. Alarm Reports

E. Operator's Manual which fully explains procedures and instructions for the operation of the system and includes:

1. Computers and peripherals
2. System start up and shut down procedures
3. Use of system, command, and applications software
4. Recovery and restart procedures
5. Graphic alarm presentation
6. Use of report generator and generation of reports
7. Data entry operator commands
8. Alarm messages and reprinting formats
9. System access requirements

F. Maintenance Manual which includes:

1. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements.
2. Detailed instructions for repair of the security system.
3. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.
4. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.

G. Test Results Manual, which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.

H. Record Drawings Manual which includes 11"x17" prints of record drawings as described below.

2.97 RECORD DRAWINGS

A. Submit the following for review and comment at the completion of the project: Drawings to fully represent installed conditions including actual locations of devices, actual cable and terminal

block numbering, and correct wire sizing as well as routing. Record changes in the work during the course of construction on blue or black line prints. Include Device addresses & IP address information. Settings for each camera (lens specs, mm setting, auto shutter setting, and other available camera settings, etc.)

B. Quality Assurance

1. Provide a project manager to coordinate the security system commissioning work with other trades.

C. Scheduling

1. Coordinate security commissioning with the General Contractor, and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.

D. Testing Requirements

1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5-day notice prior to scheduling testing. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems. At the completion of the work, test the entire system to verify proper operation. At a minimum, include these tests:

E. Building Perimeter Test: Test doors, cameras, and devices related to securing the perimeter of the building.

F. Control Panel Test: Inspect system panels, power supplies, and other related security equipment located in these areas.

G. Access Control System Test: Test the software for correct programming and setup.

H. CCTV Recording System Test: Test the recording system for correct programming, alarm recording, and event retrieval. Test and verify CCTV system viewable from workstations.

I. CCTV Camera Test: Review cameras for proper coverage, quality of video, etc.

J. Other Readers/Door Test: Test remaining card readers and doors not included in the above tests.

K. Battery and UPS Load Test: Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.

L. Documentation

1. Provide a full-sized blueline drawing containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each ACU & I/O Board) for each SEC. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC. Provide a service log on the inside door of each

SEC. Include columns for the following information: date of service, description of work performed, service technician(s), service company in the service log. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

M. Demonstration

1. On completion of the acceptance test, instruct the owner's representatives, at a time convenient to them, in the operation and testing of the system. Utilize the database for the project during training to give the users a project specific example to learn from.

2.98 ACCESS CONTROL & ALARM MONITORING

A. Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working Access Control & Alarm Monitoring system installation, as described in these specifications.

1. ACAMS control panels, input/output modules, and card readers
2. ACAMS power supplies
3. Alarm initiating devices, including: magnetic switch contacts, request-to-exit sensors, and duress buttons.
4. Interface to electric door hardware and ADA door operators

2.99 ACCESS CONTROL & ALARM MONITORING SYSTEM

A. Provide wall-mount ACAMS control panels located in the IDF rooms as indicated on project drawings. Panels will support up to 16 doors each with integrated 24VDC lock power supplies. Provide wall-mount enclosures to house ACAMS input/output modules in IDF rooms as indicated on project drawings. Provide multi-technology card readers at locations shown on the project drawings. Provide alarm contacts and request-to-exit sensors for card reader controlled doors. Provide alarm contacts for non-card reader controller perimeter doors as indicated on project drawings. Alarm only doors will route directly to the ACAMS control panels and terminate like a typical card reader door.

B. Provide local audible alarms at monitored emergency exit doors as indicated on project drawings. Local audible alarms to sound upon alarm activation (forced door, door held open, etc). Provide monitoring of the keyswitch and remote reset through the ACAMS. Provide 12/24VDC ACAMS device and lock power supplies as indicated on project drawings. Provide battery backup of system components and power supplies.

2.100 TAMPER MONITORING

A. Provide additional monitor input points for monitoring the following:
   a. Supervision of power supplies and batteries (use unsupervised inputs for this purpose).
   b. Tamper switches located within the security enclosures in the Level 2 IDF room.

B. Manufacturers

1. Access Control & Alarm Monitoring System

2. Software House to match Campus Standard

2.101 ACAMS CONTROLLERS

A. An intelligent controller with integrated battery backup, database, and communication ports that supports up to 16 card readers. Supports multiple communication channels to which a variety of devices can connect. Supports hardware modules used for additional memory and/or for future feature enhancements. Functions provided include:
   a. Central control for attached devices and addressable modules
   b. Makes decisions for access
   c. Responds to monitor activity
   d. Receives input to control its decision making
   e. Reports activity to other devices
2. Features
   a. Supports HID proximity, MIFARE, and DESFire card reader formats. Supports flash upgrades for firmware updates. Utilizes an onboard Ethernet NIC. Global input/output and anti-passback functionality. Capable of utilizing keypad commands to activate/deactivate events Supports RS-485 connectivity to addressable modules: Input Module: Supports 8 Class A supervised input points, Output Module: Supports 8 Form C dry contact relays
3. Manufacturer
   a. Software House #iSTAR Pro or equal
   b. Software House # I8 8-input module
   c. Software House # R8 8-output module

2.102 WIREWAYS

A. Provide screw cover wireway sections with open top assembly as shown on Security drawings. Provide closure plates to secure end of wireway sections. Screw Cover Gutter Wireways Type: NEMA type 1 enclosure. Size: 4” x 4” x 48” minimum. Finish: ANSI 61 gray polyester powder paint finish inside and out
1. Manufacturer:
   a. Copper B-Line or equal
   b. # 4448-G-NK lay-in painted wireway without knockouts
   c. Hoffman or equal
   d. # F44T148GVP lay-in painted wireway without knockouts
2. Accessories:
   a. Cooper B-Line or equal
   b. # 44-E-NK closure plate without knockouts
   c. Hoffman or equal
   d. # A44GCPNK closure plate without knockouts

2.103 CARD READERS

A. Presenting an access card to the reader initiates a single transmission to the ACAMS controller. Rugged, weatherized polycarbonate enclosure, designed to withstand an operating temperatures of -22 to 120 degrees Fahrenheit (-30 to 65 degrees Celsius) and operating humidity of 5-95% non-condensing.Utilizes a Wiegand protocol for communication for compatibility with standard

access control systems. Utilizes a multi-color LED and an audible sounder to indicate the status of the door. Utilizes an internal tamper switch that will indicate an alarm condition if an unauthorized attempt is made to disassemble the unit.

B. FCC and CE certified, and conform to the following ISO standards:
   a. 15693 (CSN read-only)
   b. 14443A (CSN read-only)
   c. 14443B (CSN read-only)

C. Capable of reading the following frequencies and card formats:
   a. 125kHz – HID, Indala, or AWID proximity
   b. 13.56MHz – MyD, ISO 15693 CSN (MyD, ICODE, Tag-it), ISO 14443A CSN (MIFARE, DESFire), ISO 14443B CSN, and US Government PIV

D. Manufacturer
   1. HID or equal
      a. #RP40 multi-technology card reader

2.104 MAGNETIC CONTACT SWITCHES

A. Wood, Steel, and Hollow Metal Doors
   1. Mounting: Recessed Contacts: Single Pole, Single Throw Gap Distance: 0.5” maximum

   2. Manufacturer
      a. GE Security or equal
         1. #1078 1” alarm contact switch

B. Local Audible Alarmed Doors
   1. Mounting: Recessed Contacts: Single Pole, Double Throw Gap Distance: 0.5” maximum
   2. Manufacturer
      a. GE Security or equal
         1. #1076 1" alarm contact switch

C. Request-To-Exit Motion Sensors

   1. Power: 12 or 24VDC, 35mA Relay Output: 2 form “C” contacts. Adjustable relay latch time. Programmable retrigger or non-retrigger mode. Programmable Fail Safe or Fail Secure Modes. Radio Frequency Interference (RFI) Immunity range from 26 to 1,000 MHz at 50 v/m

   2. Manufacturer
      a. Bosch or equal
         1. #DS160 with TP160 trim plate

D. Local Audible Alarms

   1. Panel operating voltage selectable 12 or 24VDC at 150mA. Keyswitch operation using rim cylinder provided by Owner to match existing standard. Utilizes 80 Db horn. Input points for door switch, alarm shunt, door status, tamper switch, and key switch override. Output points for door propped alarm, intrusion alarm, door status, tamper switch, and key switch

override. Timers for access period, warning period, and auto reset.

2. Manufacturer
   a. Designed Security
      1. #4200 local alarm sounder

E. ACAMS Power Supplies

1. Provides a 120VAC to 12 and 24VDC output, fully supervised power supply to power ACAMS field devices. Utilizes 16 PTC Class 2 rated power limited outputs. Short circuit and thermal overload protection. Integrated charger for sealed lead acid or gel type batteries. Capable of providing a 10 amp supply current. Supports a fire alarm disconnect to relay that individually selects any or all of the 16 outputs.
2. Manufacturer
   a. Altronix or equal
      1. #MAXIM75 power supply

2.105 Batteries

1. Voltage: 12.00 Amps: 12.00 Chemistry: SLA or VRLA valve regulated Termination: Spade protected terminals

2. Manufacturer
   a. Yuasa or equal
      1. #RE12-12 sealed lead acid 12V 12Ah battery

2.106 INSTALLATION

A. ACAMS Control Panels

1. Wall-mount panels in location designated on project drawings. Provide designated resistors at device end of line per manufacturer's EOL recommendation to provide four-state supervision of security device and cabling. Provide EOL supervision for alarm contacts, local alarm sounders, request-to-exit motion sensors, and other designated security devices connected to the ACAMS. Provide the following states of supervision:
   a. Contact closed = Secure
   b. Contact open = Alarm
   c. Short circuit = Line fault
   d. Open circuit = Line fault

B. Card Readers

1. Wire the card reader's multi-color LED to indicate the following status of the door. Red status indicates the door is secure (locked). Green status indicates the door is unsecured (unlocked). Yellow status indicates the card reader is not functioning (off-line/trouble), is processing a read request, or has denied access. The card reader to produce an audible beep tone to indicate to the user:
   a. The card was read and/or access was denied.
   b. Door is being held open and needs to be closed.

C. Door Hardware

1. Route power to electrically controlled locks on life-safety doors through fire alarm output to automatically unlock the door upon activation of Fire/Life-Safety system. Connect fire alarm output to the disconnect relay on the associated 24VDC lock power supply. Setup and conduct a door hardware coordination meeting. Coordinate the installation and termination of the security cable with the installation of the electric door hardware and transfer hinge. Provide cable and terminate wires to delayed egress devices for monitoring activation of delayed egress by the ACAMS system.

D. Door Contacts

1. Install on protected (secured) side of door.
2. Install 6" from leading edge at top of door.

E. Request-To Exit Motion Detectors

1. Mount motion detector on the secured (protected) side of door. Install motion detector so that detection pattern is not obstructed by Exit Signs, light fixtures and other objects that would interfere with proper operation. Adjust relay hold time and pattern to properly detect valid exit and allow shunting of door contact. Adjust detection sensitivity to pulse. Mask detector lens to provide a confined detection area limited to the door handle or pushbar.

F. Local Alarm Sounders

1. Mount local alarm sounder as indicated on project drawings.
2. Install local, square, and plumb. Set flush-mounted units so that the face of the cover, bezel, or escutcheon matches the surrounding finished surface. Mount so that there are no gaps, cracks, or obvious lines between the trim and the adjacent finished surface.

G. Programming

1. Coordinate with Owner or Owner's Representative to provide the functional programming of the Software House CCure 9000 software to serve the buildings. Owner, or Owner's Representative will provide programming of the clearances and cardholder information. Prior to the completion of construction, schedule a meeting with the Owner or Owner's Representative to determine the programming criteria. Discuss the following:
   a. Access card levels and door groupings
   b. Alarm priority levels
   c. Schedules and time codes
   d. Holidays and holiday types (priorities)
   e. Action/responses from individual input points
   f. Defining alarm messages and standard response messages applicable to site
   g. Routing of alarm points to operator's workstations, printers, and history files
   h. Coordinate implementation of graphics with Owner. Develop sample graphic complete with icons and text. Alarms to appear on building floor plans depicting the nature and location of alarms.

2.107 INTRUSION DETECTION SYSTEM

A. The IDS is comprised of multiple areas that can be armed and disarmed independently of each other.
B. The IDS is utilized for after hours monitoring of the duress buttons.

C. Intrusion Detection System

1. Provide an IDS control panel with integrated UL listed digital communicator located in IDF Room as indicated on project drawings. Panels support up to 8 areas and 75 points by use of addressable input/output point modules. Provide LCD command keypads as indicated on project drawings. Keypads allow for system arming and disarming by authorized users. Provide under counter duress buttons as indicated on project drawings. Program duress alarm inputs as 24 hours zones. Provide battery backup of IDS components and power supplies for a minimum of 24 hours in the event of a power failure or emergency. to support the security devices shown on the project drawings.

D. Tamper Monitoring

1. Provide additional monitor input points for monitoring the following: Supervision of power supplies and batteries (use unsupervised inputs for this purpose).

E. Manufacturers

1. Intrusion Detection System
2. Bosch

F. IDS Control Panels

1. Integrated UL listed digital communicator with phone line monitor (loop or ground start).
2. Supports up to75 alarm zones and 8 programmable areas or partitions. Capable of utilizing multiple telephone numbers, primary and duplicate paths with main and alternate destinations. Capable of utilizing a dual phone line switcher to monitor 2 phone lines. Capable of sending daily automatic test and status reports. Supports supervised expansion and relay output modules. Supports RS-232 connectivity to third party devices for automation.

3. Manufacturer
   a. Bosch or equal
      1. # D7412GV3 control panel

4. Accessories
   a. Bosch or equal
      1. # D8108A attack-resistant enclosure
5. Expansion modules

   a. Bosch or equal
      1. # D8128D OctpPOPIT 8-point input module

2. # D8129 Octo-relay 8-point output module

G. IDS Keypads

1. 32-character display. Keys light on entry or key press. Back lighted multi-key touch pad. User controlled brightness and loudness. Provide the ability to display for each detection point:
   a. Alarm
   b. Trouble
   c. Supervisory
   d. Faulted
   e. Custom text
   f. Low battery
   g. System wide displays include: Local system test, Sensor reset, and Event log

2. Manufacturer
   1. Bosch
   b. # D1255 alphanumeric LCD display keypad

H. Duress Buttons

1. Actuating lever, housing, and cover plate made of ABS fire-retardant plastic
2. Latching circuit with integrated LED Contact: Normally Open or Normally Closed electrical loop, SPDT
3. Operating Voltage: 12VDC

4. Manufacturer:

   a. GE Security
      1. # 3040 panic switch

2.108 INSTALLATION

A. Follow manufacturers recommended guidelines for installation.

B. IDS Control Panel

1. Place control panel and associated expansion boards in large NEMA Type-1 enclosure with ACAMS equipment. Provide standoff brackets to mount control boards to perforated panel within enclosure.
2. Place power supply and associated hardware in same location. Install supervisory and end of line resistors as required. Coordinate installation of phone jack in IDS control panel enclosure for communications to the contracted central station.

C. Keypads

1. Mount keypads as indicated on project drawings.

D. Duress Buttons

1. Mount duress buttons under work desks as indicated on the project drawings. Coordinate with architect, to field determine exact placement prior to installation.

E. Programming

1. Prior to the completion of construction, schedule a meeting with the Owner or Owner's Representative to determine the following programming criteria:
   a. Zone or alarm point descriptions
   b. User authority levels to arm/disarm areas or alarm partitions
   c. Auto arm/disarm schedules
   d. Interface requirement with ACAMS
   e. Central station response from individual alarm points
   f. Central station password and call list information

2. Document the results of the meeting and perform necessary programming to achieve the Owner's requests. Program and setup the system such that no additional programming other than entering new access codes is required.

2.109 VIDEO SURVEILLANCE SYSTEM

A. Utilizes Genetec Enterprise as video surveillance standard for IP camera systems.

B. A comprehensive and feature rich IP video surveillance system to monitor the flow of students, employees, and visitors throughout the building. The VSS consists of host servers, NVR software, fixed IP cameras, and network switches. The NVR software will reside on commercial-off-the-shelf (COTS) servers to provide a non-proprietary software based video solution.

C. CCTV Camera System

1. Provide rack-mount NVR servers and RAID-6 storage devices as indicated on project drawings. Include the following components: NVR servers. Storage appliance server and RAID-6 controller. 24TB RAID-6 storage devices Provide Arteco software on NVR servers with sufficient software licenses to support CCTV cameras indicated on project drawings. Provide megapixel IP-cameras as shown on the project drawings. Provide analog cameras within the elevator cabs as shown on the project drawings. Provide single-channel video encoders to covert analog cameras from Basement Loading Dock call station and elevator cameras to an IP format.

2. Custom Device Requirements
   a. Provide custom black powder coat trim ring for interior cameras mounted within wood slat ceiling. Interior cameras mounted in gypsum or drop tile ceiling to contain a white powder coat trim ring.
   b. Provide stainless steel finish housings for mini-dome camera housings located within elevator cars. Coordinate with specified manufacturer to furnish custom housings.

2.110 NETWORK VIDEO RECORDING SYSTEM

A. NVR Server

1. Processor: AMD 4100 series processors. Memory: 32GB DDR3 1333MHz (8x4GB) DIMMs
2. Hard Drive Configuration: RAID-1. Hard Drives: 2 x 250GB 7.2K SATA. OS: Windows Server 2008
3. Network Adapter: 2 x GbE NIC. Power Supply: 2 x 500W redundant hot swappable power supplies

B. Storage Device

1. Hard Drive Configuration: RAID-6. Hard Drives: 12 x 2TB 7.2K SATA. Power Supply: 2 x 650W redundant hot swappable power supplies

C. NVR Hardware

1. Manufacturer
    1. Intransa or equal
2. Iomnis 480 Series Servers
3. Iomnis DS Series Storage

D. NVR Software

1. Manufacturer

    a. ARTECO-SERVER Enterprise or equal

E. Network IP Cameras

1. Complete prepackaged unit containing:
    a. Sensor: 5-megapixel CMOS Sensor
    b. Resolution: 9 frames at 2592x1944, 15 frames at 2048x1536, 24 frames at 1600x1200
    c. Video compression format: H.264 and MJPEG
    d. Lens: Auto iris, varifocal lens of 4.0-8.0mm
    e. Power over Ethernet (IEEE 802.3af), Class 1
2. Connectors:
    a. Ethernet 10/100 BaseT, RJ-45
    b. Terminal block for alarm input and output
    c. Power - Mini DC
3. Features
    a. True day/night imager. Dynamic noise reduction. Programmable back light compensation. Capable of using onboard intelligent motion detection. Automatic exposure and gain control functionality

4. Manufacturer

a. Arecont Vision or equal

5. Wall-mounted installations
   a. Arecont or equal
      1. #AV5155DN 5-megapixel day/night mini-dome camera
      2. #MD-EBA electrical box adapter

6. Wood slat ceiling installations

   a. Arecont or equal
      1. #AV5105DN 5-megapixel day/night camera
      2. #HG2Z0414FC-MP megapixel auto iris lens
   b. Video Alarm
      1. #MR5C recessed ceiling mount dome housing with custom black powder coat trim ring

7. Gypsum or drop tile ceiling installations

   a. Arecont
      1. #AV5105DN 5-megapixel day/night camera
      2. #HG2Z0414FC-MP megapixel auto iris lens
   b. Video Alarm
      1. #MR5C recessed ceiling mount dome housing with standard white powder coat trim ring

F. Network 360° IP Cameras

1. Sensor: (1) 5.0-megapixel CMOS sensors. Resolution: 14 fps at 2560x1920. Video compression format: H.264 and MJPEG. Lens: CS Mount Fisheye. Power over Ethernet (IEEE 802.3af), Class 1
2. Connectors:
   a. Ethernet 10/100 BaseT, RJ-45
   b. Power - Mini DC

3. Manufacturer
   a. Sentry 360 FS-IP5000; FullSight IP 5.0 Megapixel 360 Degree Camera
4. Accessories
   a. Sentry 360 FS-DM-Dome; Vandal Mount Dome
   b. Sentry 360 FS-DM-CEILING; Ceiling Mount Adapter
   c. Sentry 360 FS-DM-WALL; Wall Mount Adapter

2.111 INSTALLATION

A. NVR Servers and RAID Storage Device

1. Rack mount servers in the telecommunications equipment rack as indicated on project drawings.
2. Install MS Windows Server 2008 and necessary client access licenses. Install NVR software.

3. Program record rate for network cameras at 15 frames per second at full resolution (2048x1536) using H.264 compression format.

B. CCTV Cameras

1. Install camera dome body above ceiling line so only dome exposed. For installations within a non-accessible ceiling, coordinate with electrical contractor to terminate conduit directly to housing for a complete plenum rated installation. Adjust the wide dynamic range, gain control, and noise reduction settings on each camera as required to provide clear and crisp video images.

C. Network Switches

1. Assign new TCP/IP addresses to network components. Rack mount network switches in designated equipment racks as indicated on project drawings. Connect fiber patch cords from fiber patch panel to SFP port(s) on switch. Connect patch cords from fiber patch panel to PoE ports.

D. Fiber Switch

1. Rack mount fiber switch in designated equipment rack in the main Server room. Connect fiber patch cords from fiber patch panels to SFP ports on switch.

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

B. Section includes grounding and bonding systems and equipment.

C. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. INFORMATIONAL SUBMITTALS

C. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in BRITISH STANDARDS, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.

B. CONDUCTORS

C. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

D. Bare Copper Conductors:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   3. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

E. Grounding Bus: Predrilled rectangular bars of annealed copper, [1/4 by 4 inches (6.3 by 100 mm)] in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

L. Straps: Solid copper lugs. Rated for 600 A.

M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

N. Water Pipe Clamps:

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad, 5/8 by 96 inches (16 by 2400 mm)].

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.

C. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8AWG and smaller, and stranded conductors for No. 6AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by British Standards:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

E. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with British Standards and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical

service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least [three] <Insert number> rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column or reinforcing steel extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than [24 inches (600 mm)] from building's foundation.

G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to BRITISH STANDARDS; use a minimum of [20 feet (6 m)] of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to British Standards; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.2 SUBMITTALS

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

C. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

D. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with British Standards (BS).

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase-and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 415/240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Color for Neutral: White
e. Color for Equipment Grounds: Green.

3. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING- AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Provide products designated for the application.

B. Snap-around Labels: Slit, pretension, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Provide products designated for the application.

C. Self-Adhesive Wraparound Labels: Preprinted 3-mil- thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretension, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"

c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

3. Tag:

a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches (75 mm).
c. Thickness: 4 mils (0.1 mm).
d. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
e. Tensile according to ASTM D 882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened or printed permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on tags not permitted.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements

2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.

3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.

3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements.

2. Engraved legend.

3. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick).
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with black letters on white face.
d. Drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

W. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

X. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

Y. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using cable ties.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, more than 600 V, within buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.

1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot (3-m) maximum intervals.

D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels vinyl tape applied in bands.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels. [to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

K. Conductors to Be Extended in the Future: Attach marker tape to conductors.

L. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

N. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

O. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with BRITISH STANDARDS and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

    a. Power-transfer switches.
    b. Controls with external control power connections.

R. Arc Flash Warning Labeling: Self-adhesive labels.

S. Operating Instruction Signs: Baked-enamel warning signs or laminated acrylic or melamine plastic signs.

T. Emergency Operating Instruction Signs: Baked-enamel warning signs or laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for [power transfer and load shedding.

U. Equipment Identification Labels:

1. Indoor Equipment: Baked-enamel signs or laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchgear.
    e. Switchboards.
    f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    g. Substations.
    h. Emergency system boxes and enclosures.
    i. Enclosed switches.
    j. Enclosed circuit breakers.
    k. Enclosed controllers.
    l. Variable-speed controllers.
    m. Push-button stations.
    n. Power-transfer equipment.
    o. Contactors.
    p. Remote-controlled switches, dimmer modules, and control devices.
    q. Battery-inverter units.
    r. Battery racks.
    s. Power-generating units.
    t. Monitoring and control equipment.
    u. UPS equipment.

END OF SECTION 260553

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensors, wire, junction boxes, power packs, control modules and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational lighting control system, as described herein with optional override for manual control.

B. Contractor shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.

C. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, luminaires, ballasts, HVAC systems and building management systems.

D. Controls manufacturer (or Contractor) to provide advanced on-site commissioning services and on-site training for facilities personnel and staff. Training to take place 60-90 days after system has been operational. Contractor to coordinate services at appropriate stages of construction.

1.2 MANUFACTURERS

A. Acceptable controls manufacturers include Light/Sensor Switch/LC&D, The Wattstopper, and Lutron. For approval, provide all the information listed under Section 1.4 a minimum of ten (14) working days prior to initial bid date.

B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any submittals made are for lighting control which meet or exceed the specifications included herein.

1.3 QUALITY ASSURANCE

A. To ensure quality and reliability, light level sensors shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

B. All components shall be U.L. listed, offer a three (3) year warranty and meet all state and local applicable code requirements.

C. All components to be by the same manufacturer.

D. Products supplied shall be from a manufacturer that has been continuously involved in the manufacturing of lighting control systems for a minimum of three (3) years with a minimum of ten (10) successful projects.

1.4 SYSTEM DESCRIPTION

A. The objective of this section is to ensure the proper installation of the lighting controls. This includes the lighting that is daylight controlled, automatically turned on when an occupant enters the area, and/or turned off after reasonable time delay when the area is vacated by the last person to occupy said area.

B. Occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. Contractor shall warrant all equipment furnished in accordance with this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The supplier's obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

D. Furnish 5% extra occupancy sensors, relays, dimming modules and light level sensors, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5 SUBMITTALS

A. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.

B. Verify proper selection of lighting control types, locations and quantities with controls manufacturer. Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor and control device that meets the design control intent.

C. Submit any interconnection diagrams per major subsystem showing proper wiring.

D. Submit standard catalog literature that includes performance specifications indicating compliance to the specification.

PART 2 - PRODUCTS

1. Provide locally available products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. It shall be the contractor's responsibility to locate and aim sensor devices in the correct location required for complete and proper coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. The locations of sensors shown on the drawings are diagrammatic and indicate only roughly where the sensors will be located.

B. It is the contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the owner's facility, to verify placement of sensors and installation criteria.

C. It is the contractor's responsibility to adjust the sensitivity settings on all occupancy and daylight sensors in accordance with design team and commissioning team comments and recommendations for optimal performance.

D. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome location difficulties due to space limitations or interference of structural components.

E. It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the control systems.

F. Controls manufacturer to provide advanced on-site commissioning services. Controls manufacturer to provide commissioning schedule to Lighting Designer (or Architect) three (3) weeks ahead of visit.

Lighting Designer (or architect) to be on-site to provide final approval of lighting scenes, dimming ranges and lighting control function. Contractor to coordinate services at appropriate stages of construction.

G. Controls manufacturer to provide on-site training for facilities personnel and staff. Training to take place 60-90 days after system has been commissioned as stated in Section E. Contractor to coordinate services at appropriate stages of construction.

3.2 OPERATION DESIGN INTENT

A. See Attached Sequence of Operations Document.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 Section Includes:

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Distribution panelboards (SMDC).
2. Lighting and appliance branch-circuit panelboards.

1.2 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.

1.5 MAINTENANCE MATERIAL SUBMITTALS

1.6 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

A. Enclosures: [Flush] [and] [Surface]-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA Type 1
b. Outdoor Locations: NEMA Type 3R

2. Height: 84 inches (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

a. Panels and Trim: Steel or galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Same finish as panels and trim.
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

B. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

C. Phase, Neutral, and Ground Buses:

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.

a. Plating shall run entire length of bus.
b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

2. Panelboards rated 415 V or less shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2.

2.3 PANELBOARDS AND DISTRIBUTION PANEL

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices: Fused switches.

G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.4 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in [transparent card holder] [metal frame with transparent protective cover].

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in British Standards (BS).

B. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box.

G. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

H. Mount surface-mounted panelboards to steel slotted supports 1 1/4 inch (32 mm) in depth. Orient steel slotted supports vertically.

I. Install overcurrent protective devices and controllers not already factory installed.

1. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

K. Install filler plates in unused spaces.

L. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

N. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:
1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Motor-control centers.
c. Panelboards.
d. Switchboards.
e. Enclosed controllers.
f. Enclosed switches.

2. Spare-fuse cabinets.

1.2 SUBMITTALS

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.
5. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 CLOSEOUT SUBMITTALS

A. See Section 01 7800 – Closeout Submittals, for submittal procedures.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.5 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250, 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 250, 600-V, zero- to 600-A rating, 200 kAIC, time delay.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting, time delay.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting, time delay.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
7. Type T: 250-V, zero- to 1200-A 600-V, zero- to 800-A rating, 200 kAIC, very fast acting, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class J, fast acting Class J, time delay Class T, fast acting.
2. Feeders: Class L, fast acting Class L, time delay Class RK1, fast acting Class RK1, time delay Class RK5, fast acting Class RK5, time delay Class J, fast acting Class J, time delay.
3. Motor Branch Circuits: Class RK1 Class RK5 Class CC, motor duty, time delay.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Power Electronics Circuits: Class J, high speed Class T, fast acting.
6. Other Branch Circuits: Class RK1, time delay Class RK5, time delay Class J, fast acting Class J, time delay Class CC, fast acting.
7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Construction Manager.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

C. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. See Section 01 7800 – Closeout Submittals, for submittal procedures.

B. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.9 WARRANTY

A. See Section 01 7800 – Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Inc.
2. Eaton.
3. General Electric Company.
4. SIEMENS Industry, Inc.; Energy Management Division.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240 or 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

2.4 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 240 600-V ac, 30 60 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 240 600-V ac, 30 60 100 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated. Circuit breaker/circuit breaker Fuse/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end-use equipment along with the statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 140 deg F (60 deg C) rated wire on 125-A circuit breakers and below 167 deg F (75 deg C) rated wire.

G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

2.6 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X,.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 263213 - DIESEL ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

B. Section includes packaged engine generators used to supply non-emergency power, with the following features:

1. Diesel engine.
2. Diesel fuel-oil system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Vibration isolation devices.
7. Finishes.

C. Related Requirements:

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour (liters per hour) at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute (cubic meters per minute) at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F (35, 27, 21, and 10 deg C). Provide Drawings indicating requirements and limitations for location of air intake and exhausts.

7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer] [manufacturer] [and] [testing agency].

B. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, including full fuel tank, external silencer, subbase-mounted fuel tank and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar, Inc.; Electric Power Division.

2. FG Wilson

3. Perkins

B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine generator housing, subbase fuel tank, engine generator, batteries, battery racks, silencers, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. UL Compliance: Comply with UL 2200.

C. Noise Emission: Comply with applicable government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

D. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Power Rating: Prime.

D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.

E. Service Load: As identified on the drawings.

F. Power Factor: 0.8 lagging.

G. Frequency: 50 Hz.

H. Voltage: 220/400 V ac.

I. Phase: Three-phase, four wire, wye

J. Induction Method: Naturally aspirated or Turbocharged.

K. Governor: Adjustable isochronous, with speed sensing.

L. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

M. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

N. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: 10 seconds.

O. Parallel Engine Generators:

1. The generator will be paralleled with other units in the future, provide required on board electronics for this future configuration.

2.4 DIESEL ENGINE

A. Fuel: ASTM D 975, diesel fuel oil, Grade 2-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid-mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.

E. Fuel coolers to be provided from generator manufacturer to remove excess heat from the diesel fuel.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Semicritical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 18 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

H. Air-Intake Filter: Standard duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 24 V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Nickel cadmium, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F (10 deg C) regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for nickel-cadmium batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F (minus 40 to plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

D. Fuel Filtering: Remove water and contaminants larger than 1 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. As recommended by engine manufacturer for an uninterrupted period of 8 hours operation at 100 percent of rated power output of engine generator system without being refilled. An additional standalone fuel tank shall be provided by others for a total backup of 96 hours. Provide all necessary provisions for the fuel tank connection and fuel circulation.
2. Tank level indicator.
3. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills.
4. Leak detection in interstitial space.
5. Vandal-resistant fill cap.
6. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.6 CONTROL AND MONITORING

A. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 30 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

    a. Engine lubricating-oil pressure gage.
    b. Engine-coolant temperature gage.
    c. DC voltmeter (alternator battery charging).
    d. Running-time meter.
    e. AC voltmeter, connected to a phase selector switch.
    f. AC ammeter, connected to a phase selector switch.
    g. AC frequency meter.
    h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:

    a. Cranking control equipment.
    b. Overcrank alarm.
    c. Overcrank shutdown device.
    d. Low-water temperature alarm.
    e. High engine temperature pre-alarm.
    f. High engine temperature.

g. High engine temperature shutdown device.
h. Overspeed alarm.
i. Overspeed shutdown device.
j. Low fuel main tank.

1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required in "Fuel Tank Capacity" Subparagraph in "Diesel Fuel-Oil System" Article.

k. Coolant low-level alarm.
l. Coolant low-level shutdown device.
m. Coolant high-temperature prealarm.
n. Coolant high-temperature alarm.
o. Coolant low-temperature alarm.
p. Coolant high-temperature shutdown device.
q. Battery high-voltage alarm.
r. Low cranking voltage alarm.
s. Battery-charger malfunction alarm.
t. Battery low-voltage alarm.
u. Lamp test.
v. Contacts for local and remote common alarm.
w. Low-starting air pressure alarm.
x. Low-starting hydraulic pressure alarm. y.
Remote manual stop shutdown device. z.
Air shutdown damper alarm when used.
aa. Air shutdown damper shutdown device when used.
bb. Generator overcurrent-protective-device not-closed alarm.
cc. Hours of operation.
dd. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

F. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.

B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator output rating.
3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
4. Mounting: Adjacent to, or integrated with, control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class F.

D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

E. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.9 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

A. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine generator manufacturers' written installation and alignment instructions.

B. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases.
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Cooling System: Install Schedule 40 black steel piping with welded joints for cooling water piping between engine generator and [heat exchanger] [remote radiator]. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."

1. Install isolating thimbles where exhaust piping penetrates combustible surfaces. Provide a minimum of 9 inches (225 mm) of clearance from combustibles.
2. Insulate cooling-system piping and components according to requirements in Section 230719 "HVAC Piping Insulation."

D. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."
2. Install flexible connectors and steel piping materials according to requirements in Section 232116 "Hydronic Piping Specialties."
3. Insulate muffler/silencer and exhaust system components according to requirements in Section 230719 "HVAC Piping Insulation."
4. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches (225 mm) of clearance from combustibles.

E. Drain Piping: Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40 black steel pipe with welded joints.

1. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."
2. Drain piping valves, connectors, and installation requirements are specified in Section 232116 "Hydronic Piping Specialties."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

G. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Perform insulation-resistance tests according to IEEE 43.

            a) Machines Larger Than 200 hp (150 kW): Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 hp (150 kW) or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Verify correct functioning of the governor and regulator.

2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
5. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
6. Exhaust Emissions Test: Comply with applicable government test criteria.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.

C. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

D. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Remove and replace malfunctioning units and retest as specified above.

G. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

H. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.14

SECTION 26 3600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Remote annunciator and control system.

1.2 SUBMITTALS

A. See Section 01 3000 – Administrative Requirements, for submittal procedures.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

C. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, power sources, and load.
4. Riser Diagram: Show interconnection wiring between transfer switches,, generator,, annunciators, and control panels.

D. Qualification Data: For manufacturer-authorized service representative.
1. Furnish a letter signed by a qualified representative of the switch assembly stating:
   a. The manufacturer maintains a factory/parts warehouse within 50 miles of the jobsite, stocked with all parts for the automatic switch assembly.
   b. A factory authorized service representative lives within 50 miles of the jobsite.
   c. Parts and service are available year round on a 24-hour, 365 days per year basis.
   d. Response time to an emergency call from the jobsite for service or parts will not exceed three (3) hours.

E. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. See Section 01 7800 – Closeout Submittals, for submittal procedures.

B. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

   a. Features and operating sequences, both automatic and manual.

b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
c. Instructions for routine maintenance
d. Detailed instructions for repair of the transfer switch.
e. Pictorial parts list and part numbers.
f. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators
g. Telephone numbers for the authorized parts and service distributors.
h. Include all service bulletins and torque specifications for all terminations.
i. Final testing reports

1.4 QUALITY ASSURANCE

A. Basis of Design: Specifications are based on GE types by specified basis of design manufacturer. GE types manufactured by other by other acceptable manufacturers are permitted, subject to compliance with specified requirements; and provided that deviations in design, performance, weight, size, profile, and other essential characteristics are minor, and do not detract substantially from the indicated design intent.
1. Comply with requirements specified in Section 01 4000 and Section 01 6000.

1.5 WARRANTY

A. See Section 01 7800 – Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Manufacturer’s standard warranty period from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in British Standards (BS), by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 110: Standard for Emergency and Standby Power Systems.

F. Comply with UL 1008: Transfer Switch Equipment unless requirements of these Specifications are stricter.

G. Current Ratings (As indicated on the drawings): Apply as defined in UL 1008 for continuous loading and total system transfer.

H. Tested Fault-Current Closing and Short-Circuit Ratings (As indicated on the drawings): Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Short-time withstand capability for three cycles.

I. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

J. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

K. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

L. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

M. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed tape markers at terminations.

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

O. Enclosures: General-purpose NEMA 250, Type 1 complying with NEMA ICS 6 and UL 508, unless otherwise indicated on the drawings.

P. Nameplates: Provide each transfer switch with an engraved laminated-plastic nameplate mounted with corrosion-resistant screws in accordance with the provisions of Section 260553 Identification for Electrical Systems. Nameplate shall have red background with white letters.

Q. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
2. Ground Lugs and Bus Configured Terminators: Mechanical type.

R. Power Monitoring: Provide each transfer switch with a Square D PM850 PowerLogic meter. Locate the CT's and PT's on the line side bus.

S. BMS Interface: Provide interface module in each transfer switch to allow connection to the Building Management System via Modbus protocol. The following points shall be monitored:

1. Emergency Source Available
2. Normal Source Available
3. Switch On Emergency Source
4. Switch On Normal Source
5. Engine Start signal
6. Load Shed signal

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cummins Power Generation
2. Eaton.
3. Emerson (ASCO).
4. GE Zenith Controls.
5. Generac Power Systems, Inc.
6. General Electric Company.
7. Kohler Power Systems.
8. MTU Onsite Energy Corporation.
9. Russelectric, Inc.
10. Substitutions not permitted.

B. Comply with Level 2 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Mechanical type.
7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
8. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Provide one set of contacts per elevator as indicated on the drawings. Interval shall be adjustable from 1 to 30 seconds.

G. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available" or “Source 1 Available.”
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available” or “Source 2 Available.”

8. Unassigned Auxiliary Contacts:
    a. Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
    b. One normally open, single-pole, double-throw contact for normal power available, rated 10 A at 240-V ac.
    c. One normally open, single-pole, double-throw contact for emergency power available, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

H. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2.3 TRANSFER SWITCH ACESSORIES

A. Remote Annunciator and Control System:

1. Source Limitations: Same manufacturer as transfer switch.
2. Include the following functions:

a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
b. Indication of switch position.
c. Indication of switch in test mode.
d. Indication of failure of digital communication link.
e. Control of switch-test initiation.
f. Control of switch operation in either direction.
g. Control of time-delay bypass for transfer to normal source.

3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

a. Controls and indicating lights grouped together for each transfer switch.
b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
c. Mounting: Flush Surface, modular, steel cabinet unless otherwise indicated.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. A. Install transfer switches in accordance with manufacturer’s instructions.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Wire controls to generators, remote annunciator panels and BMS connections as required. Provide type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as determined by the manufacturer.

B. Wiring Method: Install cables in raceways except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 CLEANING

A. Comply with the provisions of Section 017700 – “Closeout Procedures.”

B. Touch up scratched or marred surfaces to match original finish.

C. Thoroughly wipe dirt and dust from devices and components. Vacuum transfer switch interior after cleaning devices.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.
e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match the Manufacturer’s Shop Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:
a. Perform a contact-resistance test. Compare measured values with manufacturer's acceptable values.
b. Verify settings and operation of control devices.
c. Calibrate and set all relays and timers.
d. Verify phase rotation, phasing, and synchronized operation.
e. Perform automatic transfer tests.
f. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.

3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Transfer switches will be considered defective if they do not pass tests and inspections.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

B. Section includes field-mounted SPDs for low-voltage (220 to 600 V) power distribution and control equipment.

C. Related Requirements:
1. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in British Standards (BS), by a qualified testing agency, and marked for intended location and application.

B. Comply with British Standards (BS).

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB USA.
2. Current Technology Inc.
3. Eaton.
4. General Electric Company.
5. LEA International.
6. Leviton Manufacturing Co., Inc.
7. Liebert; a brand of Emerson Electric Co.
8. Schneider Electric USA, Inc.
9. SIEMENS Industry, Inc.; Energy Management Division.
10. Square D; by Schneider Electric.

B. SPDs: Comply with UL 1449, Type 2.

1. SPDs with the following features and accessories:

a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
b. Indicator light display for protection status.
c. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 320 kAThe peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 400/220 V three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 400Y/220 V
2. Line to Ground: 1200 V for 400Y/220 V
3. Line to Line: 2000 V for 400Y/220 V.

F. SCCR: Equal or exceed 200 kA.

G. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB USA.
2. Current Technology Inc.
3. Eaton.
4. LEA International.
5. Schneider Electric USA, Inc.
6. SIEMENS Industry, Inc.; Energy Management Division.
7. Square D; by Schneider Electric.

B. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 400Y/220 V three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 400Y/220 V.
2. Line to Ground: 1200 V for 400Y/220 V.
3. Neutral to Ground: 1200 V for 400Y/220 V.
4. Line to Line: 2000 V for 400Y/220 V.

F. SCCR: Equal or exceed 200 kA.

G. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

2.5 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

B. Section includes the following types of LED luminaires (not all these types will be used in this phase of the project, they remain for future phases):

1. Cylinder.
2. Downlight.
3. Highbay, linear.
4. Linear industrial.
5. Lowbay.
6. Recessed linear.
7. Strip light.
8. Surface mount, linear.
9. Surface mount, nonlinear.
10. Surface mount, above door.
11. Suspended, linear.
12. Suspended, nonlinear.
13. Materials.
14. Finishes.
15. Luminaire support.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

B. Product Test Reports: For each luminaire, for tests performed by manufacturer.

C. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. User Replaceable Lamps:

a. Bulb shape complying with ANSI C78.79.

C. CRI of minimum 80 CCT of 3500 K.

D. Rated lamp life of 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

G. Nominal Operating Voltage: 240 V ac

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

H. Housings:

1. Extruded-aluminum.
2. Powder-coat

2.3 STRIP LIGHT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. OSRAM SYLVANIA.
5. Philips Lighting Company.

B. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.4 SURFACE MOUNT, LINEAR

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lightolier; a Philips group brand.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Minimum 750 lumens. Minimum allowable efficacy of 80 lumens per watt.

C. Integral junction box with conduit fittings.

2.5 SURFACE MOUNT, ABOVE DOOR

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Lighting, an Eaton business.
2. GE Lighting Solutions.
3. Lightolier; a Philips group brand.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Integral junction box with conduit fittings.

2.6 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

C. Housings:

1. Extruded-aluminum housing and heat sink.
2. Powder-coat finish.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.7 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.8 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, [12 gage (2.68 mm)].

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Do not attach luminaires directly to gypsum board.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

B. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps, Lenses, Optical Parts, Diffusers, Globes and Guards: Provide one spare part for every 10 units purchased. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

C. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 1598 and listed for wet location.

C. Lamp base complying with ANSI C81.61.

D. Bulb shape complying with ANSI C79.1.

E. CRI of minimum 80. CCT of 4100 K.

F. L70 lamp life of 50,000 hours.

G. Internal driver.

H. Nominal Operating Voltage: 240 V ac.

I. In-line Fusing: Separate in-line fuse for each luminaire.

J. Lamp Rating: Lamp marked for outdoor use.

K. Source Limitations: Obtain luminaires from single source from a single manufacturer.

L. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at low light levels and off when day light is present with 15-second minimum time delay.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.

2.4 LUMINAIRE TYPES

A. Area and Site:
1. Luminaire Shape: As stated on luminaire schedule.
2. Mounting: As stated on luminaire schedule.
3. Luminaire-Mounting Height: As stated on luminaire schedule.

4. Distribution: As stated on luminaire schedule.
5. Diffusers and Globes: As stated on luminaire schedule.
6. Housings: As stated on luminaire schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install per local codes and regulations.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.

D. Wiring Method: Install cables in raceways. Conceal raceways and cables.

E. Install luminaires at height and aiming angle as indicated on Drawings.

F. Coordinate layout and installation of luminaires with other construction.

G. Adjust luminaires that require field adjustment or aiming.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.254-mm thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265619

SECTION 275223 - NURSE CALL/CODE BLUE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Audiovisual/voice wired nurse-call system, as a small system with only one ward control center.
   a. The nurse call system shall be located near the ward beds.
   b. The Ward Control Center shall be located at the Nurses Station.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment cabinets and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Cabling Diagrams: Single-line block diagrams showing cabling interconnection of all components for this specific equipment. Include cable type for each interconnection.
3. Station Installation Details: For built-in equipment, dimensioned and to scale.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For nurse-call equipment to include in emergency, operation, maintenance and installation manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Prior to final payment, provide spare parts and extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: All colors for corridor dome lights and zone lights equal to 20 percent of amount installed.
2. Fuses: One for every 10 of each type and rating, but no fewer than two of each.
3. Printed Circuit Boards: Each kind, equal to 10 percent of amount installed, but no fewer than one unit.
4. Master-Station Privacy Handset: One.
5. System program backup software.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Compatibility: System shall be capable of integration with any brand of phone system (wired or wireless), staff locating system, CCTV, and fire-alarm system.

C. Electrical Components, Devices, and Accessories: Listed and labeled according to UL 1069 as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace batteries that fail in materials or workmanship within specified warranty period. Special warranty for batteries applies to materials only, on a prorated basis for specified period.

1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
   a. Nickel-Cadmium Batteries, Lithium Batteries, and Wet-Cell Batteries:
      1) Full Warranty: Five years.

1.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support free of charge for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 NURSE-CALL SYSTEM GENERAL REQUIREMENTS

A. Station Zones: Able to program station zones for each master station in the network with priority levels and addressable visual and audible annunciation of audible devices such as smoke detectors and door contacts.

B. System shall provide integrated and centralized "Code Blue" and "Staff Emergency" calls.

C. Expansion Capability: Equipment ratings, housing volume, spare keys, switches, relays, annunciator modules, terminals, and cable conductor quantities adequate to increase the number of stations in the future by 25 percent above those indicated without adding internal or external components or main trunk cable conductors.

D. Resistance to Electrostatic Discharge: System, components, and cabling, and the selection, arrangement, and connection of materials and circuits, shall be protected against damage or diminished performance when subjected to electrostatic discharges of up to 25,000 V in an environment with a relative humidity of 20 percent or less.

E. Equipment: Microprocessor, electronic, modular.

F. Master Nurse-Call Station: Programmed via a PC.

G. Wall-Mounted Component Connection Method: Components connect to system wiring in back boxes with factory-wired plug connectors.

H. Telephone Interface: Permit use of wired and wireless telephones to execute nurse-call master station functions.

I. Third-Party Pager Interface: Programmable to send tone, numeric, and alphanumeric message to pocket pagers or personal digital assistants and to use industry standard-protocol, RS-485 interface.

2.2 AUDIOVISUAL/VOICE NURSE-CALL SYSTEM

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide products by Gira Giersiepen GmbH & Co. KG; Nurse Call System Plus or comparable product by one of the following:

1. Hill-Rom.
2. Rauland a division of AMETEK, Inc.
3. Jeron Electronic Systems.
4. Architect approved equal.

B. System Description: Small System

1. The ward control center serves as the central control element with switch and duty room terminal CT9.
2. Self-monitoring of the system (creation of log files) shall be automatic.

C. Operational Requirements:

1. Station Selection from Master Station: Capable of selectively communicating with other stations or groups of stations on its system by touch screen, mouse click, or manual switch.
2. Master Station Privacy: Capable of conversing with individual stations in complete privacy.
3. Called Station:

    a. Capable of hands-free and two-way conversation.
    b. Pressing "talk/listen" key shall cause the annunciation tone to cease.
    c. Pressing "cancel" key terminates normal calls and conversations.
    d. Terminating of high-priority level shall not be allowed except at calling station location and shall send "remind" message if the call is not acknowledged at point of origin in programmed time frame.

4. Annunciation:

    a. At the master station, a programmable tone announces an incoming call; an annunciator light or digital display identifies the calling station and indicates the priority of the call.
    b. Call type indications include alarm assist, bath, bed, code, communication fault, cord out, door, emergency, and fire.
    c. Memory lamps or lighted displays identify stations selected for outgoing calls.

5. System Reset at Master Station: A normal, incoming call can be canceled, associated lights and audible tones extinguished, and the system reset when the station switch is returned to the normal position.
6. Patient Station Calls:

    a. Lights the call-placed lamp at patient station, zone, and corridor dome lights.
    b. Sounds a tone and lights the call lights at staff/duty stations and actuates annunciation at the master station.
    c. When the calling station is selected at the master station, the patient can converse with the master station without moving and without raising or directing the voice.

7. Pull-Cord-Call Station Calls and Emergency-Call Station Calls:

    a. Lights call-placed lamp and corridor dome light and flashes zone light.
    b. Master station tone pulses and annunciator light for that room flashes.
    c. When master station acknowledges the call by touch screen or switch, the tone stops but lights continue to flash until the call is canceled at the initiating point.

8. Code Blue and Staff/Duty Station Calls:

    a. Lights the call-placed lamp at the station and actuates annunciation at the master station.
    b. When the called station is selected at the master station, the caller and the master station operator can converse.

c. Code Blue: Unique sound and light pattern indicating the highest priority emergency.
d. Staff Station: Unique sound and light pattern indicating an emergency.
e. Duty Station: Sound and light pattern indicating a call to the nurse station.

9. Handset Operation: Lifting the handset on master station disconnects speaker/microphone and transfers conversation to the handset.
10. Station Privacy: No patient or staff/duty station can be remotely monitored without lighting a warning lamp at the monitored station.
11. Patient Station Cord-Set Removal:

a. A patient station call is initiated as described above when a patient station cord-set plug is removed from the jack in the station faceplate.
b. Tone stops but lights continue to flash until the call is canceled at the initiating point or the plug is reinserted or replaced with a dummy plug when the master station call button for the station is pressed.

12. Patient Control Unit:

a. Speaker is used for communication.
b. Nurse button on the unit initiates a patient station call.

13. Selective Paging: Master station is capable of initiating a message to selected groups of stations or speakers simultaneously by using station group switches.
14. Staff Reminder:

a. Master station can initiate a staff reminder that a patient requires direct staff response by operating a reminder control while in contact with the patient station.
b. This reminder will light a distinctive-color lamp in the corridor dome light at the patient's room and in the appropriate zone lights.
c. Reminder calls are canceled by operating a staff reminder cancel switch in the patient's room.

15. Additional Call:

a. Waiting display window on the master station similar to current call window displays incoming calls.
b. Master station shall have a call-overflow indicator when incoming calls exceed number of calls as directed by Owner.
c. System shall store unlimited number of incoming calls.
d. System shall be capable of automatically answering incoming calls in order of priority.

16. Calling Intercom Stations:

a. Master station shall be capable of calling any intercom station using the handset or the hands-free speaker/microphone.
b. Receipt of a call at the intercom station shall be preceded by an optional pre-announce tone.
c. If there is a call in process, system shall place the active call on automatic hold while the new call is placed, then reestablish the previous call when the new call has ended.

17. Privacy Override:

a. Temporarily deactivates the "Privacy" mode of a called station by calling the station and instructing the called party to press the call-cord button.
b. On completion of the conversation, the called station shall automatically return to the "Privacy" mode.
c. When in "Privacy" mode, a called station shall be capable of hearing the master station; however, the master station shall not be capable of hearing the called station; a privacy message shall be indicated on the master station display.

18. Master-Station-to-Master-Station Calls:

a. Master stations shall be capable of calling other master stations using the handset.
b. Calls from master stations shall be answered using the handset only.
c. Busy master stations shall be indicated by a master station intercom busy tone.

19. Voice Paging:

a. Capable of voice paging to all stations using a single "All Call" key. The page shall be preceded by an optional pre-announce tone.
b. Capable of voice paging to eight user-defined groups of stations by selecting the group and then the "All Call" key. The page shall be proceeded by a pre-announce tone.
c. Capable of voice paging to all staff/duty stations and all patient stations where staff has registered presence using a single "Public Address (PA)/Staff" key. The page shall be proceeded by a pre-announce tone.
d. Capable of voice paging through a third-party PA system.
e. Capable of including or excluding any station from the voice paging function(s).
f. Automatically places an active station call on hold during any page and reestablishes the connection at the end of the page.
g. Automatically cancels a page if the talk mode is inactive for more than 15 seconds.

20. Station Monitor:

a. An audio monitor feature shall allow a user to sequentially or simultaneously listen to one or all stations that are included in the user-created list.
b. Master station display shall indicate which station is being monitored when in sequential mode.
c. The dwell time each station is monitored shall be user programmable.
d. The user shall be able to stop the monitoring sequence by activating a "pause" key.
e. The user shall be able to manually sequence through stations using a "next" key.

21. Night Service:

a. Functions shall be adaptable for nighttime staffing levels, patient traffic, and day/night operations.
b. Staff Follow:

1) Capable of locating roving staff; forwarding visual and audible annunciation of incoming calls to station(s) where personnel have registered presence.
2) Master station shall display locations where staff have registered presence.
3) Incorporates a programmable timer that automatically cancels a forgotten staff presence registration.

c. Tones:

1) Deactivates audio signals from a duty station and mini-master display telephones.
2) Capable of changing the tone volume at the master and duty stations.
3) Satellite function shall permit the user to deactivate audio signals from duty stations and other remote annunciator devices.

d. Transfer:

1) Permits one nurse station to take control of all or individually selected bed call cords from another nurse station. It shall be possible to view transfer status of a nurse station.
2) Includes a minimum of three transfer modes to allow one nurse station to take control or share calls and operations from another nurse station.

a) Parallel Transfer Mode: Permits both nurse stations to share all calls and operations.
b) Supervised Transfer Mode: Permits the transferred nurse station to share all calls and operations with the controlling nurse station; however, the controlling nurse station calls are not shared with the transferring station.
c) Capture Transfer Mode: Transfers all calls and operations from the transferred nurse station to the controlling nurse station.
d) Transferred station shall have no control over calls, and its display shall indicate calls have been transferred to another station.

3) Includes two "patient swing" modes to allow one nurse station to take control or share calls from one or many calls from another nurse station.

a) Supervised Transfer Mode: Permits the transferred calls to be shared with the controlling nurse station.
b) Capture Transfer Mode: Transfers all calls from the call cord from the transferred nurse station to the controlling nurse station.
c) Transferred station has no control over those transferred calls.

22. Service Request:

a. Permits users to assign a service request to a substation, at programmable priority level.
b. Displays service request on the nurse station display and light the green flashing corridor lamp at the respective substation and automatically generate a service reminder request.
c. Cancels service requests only at the initiating point.
d. Recall calls shall sound and be displayed at the master station if the service request has not been cancelled at the initiating point within the programmed period of time.

23. Call Reminder Function:

a. Automatically generates a reminder call for a patient- or staff-initiated, high-priority request that has had the call tones silenced, allowing time to physically attend to the request and cancel the call at the initiating point.
b. Regenerated calls shall display the same tones and visual indications and priority as the original call and shall also display a "regenerated call" message.
c. Capable of manually adding low-priority calls to the reminder list.

d. "Call Reminder" function and reminder timer shall be programmable by call priority.

24. Hide Function: Prevents a selected station from displaying calls or generating tones on the nurse station.
25. Door Control Function: Capable of being programmed to enable the user to remotely activate electric door locks.
26. Test and Diagnostics Feature:

    a. Able to automatically diagnose system faults and categorize them as warnings, communication errors, or fatal errors.
    b. Warnings shall indicate possible system problems.
    c. Communication errors shall indicate the inability of the master station to communicate with a substation or another nurse-call station.
    d. Fatal errors shall indicate a major hardware or software failure.

27. User-Configured System Programming - Access Code Not Required:

    a. Patient call-cord priority levels.
    b. Monitor list.
    c. "All Call" list.
    d. Master station communication parameters (volume, filtering, talk/listen, sensitivity).
    e. Master and duty station call annunciation tone volume.
    f. Date/time.
    g. Staff-follow operating mode.
    h. Transfer type.
    i. Pocket pager list assignment.
    j. Presence mode.

28. User-Configured System Programming - Access Code Required:

    a. Master station number.
    b. Room device type.
    c. Room number.
    d. Bed number.
    e. Bed alpha or numeric.
    f. Reminder duration.
    g. Staff presence registration cancel duration.
    h. Display language.
    i. Paging group assignment(s).
    j. Zone group assignments.
    k. Monitoring duration.
    l. Pocket pager number.
    m. Call tone assignment by priority.
    n. Pretone activation.
    o. Call tones minimum volume.
    p. Clock mode (12 h/24 h).

D. Master Station:

1. Speaker/microphone unit with operating controls.
2. Indicator lamps with legends or by digital display designate identification and priority of calling stations and called stations.
3. Pulse rate of incoming-call lights denotes priority of calls awaiting response.
4. Station Selection Controls: Touchpad select stations for two-way voice communications.
5. Signal Tones: Programmable to announce incoming calls.

6. Pulse rate and frequency of tone identify the highest priority call awaiting response at one time.
7. Volume Control: Regulates incoming-call volume.
8. Privacy Handset with Hook Switch: Of the type that does not require push-to-talk switch attached to each station unless otherwise indicated.
9. Staff Reminder Control: Initiates flashing of corresponding corridor dome lights for patients requiring service. Permits scanning equipment to indicate which patients are currently in reminder status.
10. Call Priority Selection: Controls associated with patient-station selection switches determine the priority displayed when a call is initiated at a patient station.

E. Central Equipment Cabinet:

1. Lockable metal.
2. Houses amplifiers, tone generators, power supplies, controls, terminal strips, and other components.
3. Amplifier: With fidelity and overall gain necessary to achieve the sound-transmission and reproduction characteristics specified, considering interoperability with the installed speakers/microphones and wiring.
    a. Power Output: Not less than 3 W at a total harmonic distortion not exceeding 5 percent.
    b. Hum and Noise: 60 dB below full output with normal input open.
    c. Volume Control: Concealed within the amplifier unit to control the volume of sound reproduced at all stations.
    d. Protection: Circuit to prevent damage to the amplifier in case of shorted or open circuit.
4. Selective Paging Amplifiers: Plug-in card mounted in central equipment cabinet, rated 15 W.
5. System Power Supply:
    a. 24-V dc for operation of the call system.
    b. Equipment Rating: Suitable for continuous operation between 32 and 120 deg F (0 and 49 deg C), from a primary line voltage between 105- to 125-V ac, 60 Hz.
    c. Output: Regulated 24-V dc with protection against overloads. Line-to-load regulation shall not exceed 2-1/2 percent with ripple and noise remaining below the 10-mV, rms level.
    d. Overload Protection: Electronic fold-back circuit set to limit the volt-ampere output to less than 100 VA during overloaded or shorted output. Restore power output automatically on removal of overload without resetting circuit breakers or replacing fuses.
6. Power-on indicator lamp.
7. Surge Protector Device: As recommended by the manufacturer.
8. Battery Backup Unit: Sealed nickel-cadmium, wet-cell battery supplies power through an automatic switch when normal power fails, for a period of not less than six minutes at rated output.
    a. Automatic retransfer to normal power, after a 15 minute time delay.
    b. Two-rate battery charger with an automatic trickle rate and a recharge rate.

F. Speaker/Microphones:

1. Type: Permanent-magnet, dynamic or ceramic, protected against dust and humidity.
2. Sound Reproduction: Sound level of 90 dB plus or minus 3 dB at a distance of 1220 mm on the axis without overdriving or distorting any frequencies between 300 and 3000 Hz when installed in an enclosure or in the pillow speaker.
3. Power Handling Capacity: Not susceptible to damage from overdriving within the range of power available from the amplifier.

4. Impedance Matching: Coordinated and matched to the input and output circuits of the amplifier, both for single connection and for group monitoring, to provide the sound reproduction specified. Subsystems or components shall not be combined, which could cause unacceptable distortion such as feedback between pillow speakers and unmuted room speaker/microphone combinations. This protection shall extend throughout the entire range of operation (volume control) of all components.

G. Single-Patient Station: Speaker/microphone with 50-mm dynamic cone, a polarized receptacle to match the cord-set plug, monitor lamp, reset switch, and call-placed lamp; assembled under a single faceplate.

H. Dual-Patient Station:

1. Speaker/microphone with 50-mm dynamic cone, two polarized receptacles to match cord-set plugs, monitor lamp, and reset switch; assembled under a single faceplate.
2. Dual call-placed lamps, one for each bed.

I. Staff/Duty Stations: Audible call-tone signal device, speaker/microphone with 2-inch 50-mm dynamic cone, monitor lamp, reset switch, routine-call lamp, emergency-call lamp, and call push button; assembled under a single faceplate.

J. Code Blue Station: Audible call-tone signal device, speaker/microphone with 50-mm dynamic cone, monitor lamp, reset switch, Code Blue emergency-call lamp, and call push button; assembled under a single faceplate.

K. Ambulatory-Patient Station: Speaker/microphone with 50-mm dynamic cone, monitor lamp, reset switch, call-placed lamp, and call push button; assembled under a single faceplate.

L. Selective Paging Speakers: 200-mm cone type with 1-inch 25-mm voice coil and minimum 140-g ceramic magnet, multitap matching transformer, flush-mounted steel back-box, and white enamel-finished metal ceiling grille.

M. Call Priority Switch Station: Three-position, tamper-resistant priority selection switch. Positions designated by labeling "Normal," "Emergency," and "Priority."

N. Staff Reminder Cancel Switch Station: Momentary contact.

2.3 SYSTEM COMPONENTS

A. Code Blue Station:

1. Consists of a sliding, chemical-resistant, ABS blue fascia marked with the word "CODE" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Water resistant and able to withstand routine cleaning and chemical disinfectants.
5. Uses magnetic reed switch technology for reliability and corrosion resistance.

6. Mounts on a single-gang electrical box wire to the respective patient station or input controller.

B. Staff, Emergency Station / Code Pink Dual Station:

1. Consists of a sliding, chemical-resistant, ABS red fascia marked with the word "EMERGENCY" in bold letters.
2. Capable of being activated with nylon pull cord or by sliding the face of the unit downwards.
3. Activation of the station shall illuminate a reassurance digital display on the face of the unit in addition to notifying the master station.
4. Mounts on a single-gang electrical box wire to the input controller.

C. Pull-Cord-Call Station:

1. Pull-Down Switch: Lever-locking type, labeled "Pull Down to Call Help."
2. Reset trigger.
3. Call-placed lamp.
4. Water-resistant construction.

D. Patient Control Unit:

1. Equipped with plug and 2400-mm long white cord.
2. Ethylene oxide, sterilizable.
3. Light-Control Switch: Arranged for independent on-off control of patient's up and down light.
4. Integral Speaker: 50 mm, with 9.9-g magnet, rated 0.2 W.
5. Controls: Speaker volume and nurse call.
6. Housing: High-impact white plastic.
7. Attachment: Stainless-steel bed clamp with permanently attached polyester film strap.
8. Quantity: 12 units for every 10 patient beds.

E. Call-Button Cord Set:

1. Plug and 1800-mm white cord; cord set shall be resistant to medical gas environment equipped with momentary-action, call-button switch.
2. Ethylene oxide, sterilizable.
3. Washable cord.
4. Palladium switch contacts in high-impact white housing with cord-set strain relief.
5. Attachment: Stainless-steel bed clamp with permanently attached polyester film strap.
6. Quantity: Three cord sets for every 10 patient beds.

F. Indicator Lamps: Digital type with rated life of 20 years unless otherwise indicated.

G. Station Faceplates:

1. Stainless steel, a minimum of 0.95 mm thick.
2. Finish: Brushed.
3. Machine-engraved labeling identifies indicator lamps and controls.

H. Station Faceplates:

1. High-impact plastic.
2. Color: As selected by Architect from manufacturer's standard colors.
3. Molded or machine-engraved labeling identifies indicator lamps and controls.

I. Corridor Dome Lights and Zone Lights:

1. Three-lamp signal lights.
2. Lamps: Front replaceable without tools, low voltage with rated life of 7500 hours. Barriers are such that only one color is displayed at a time.
3. Lenses: Heat-resistant, shatterproof, translucent polymer that will not deform, discolor, or craze when exposed to hospital cleaning agents.
4. Filters: Two per unit, amber and red.

J. Cable:

1. Conductors: Jacketed single and multiple, twisted-pair copper cables.
2. Sizes and Types: As recommended by equipment manufacturer.
3. Cable for Use in Plenums: Listed and labeled for plenum installation.

K. Grounding Components: Refer to Drawings and Building code for requirements.

2.4 SOFTWARE REQUIREMENTS

A. Telephone System Interface:

1. Permits use of wired and/or wireless telephones to execute nurse-call master station.
2. Two-way communication with patient and staff stations.
3. Two-way communication with the master nurse station.
4. "All Call," group call, and staff call paging.
5. Capable of being programmed to forward calls destined for a master nurse station to any connected telephone.
6. Telephones connected to the telephone interface shall have the same call tone ring patterns as those generated at the master nurse station.
7. Telephones having a display shall indicate the call type, priority code, and the calling station number of incoming calls.
8. Telephones shall be capable of initiating a service request for a particular patient station, logging calls on the master station's reminder list, and activating door lock mechanisms associated with a call station.
9. Capable of routine setup and configuration changes using the keypads on display telephone and/or the master station.

B. Display Telephones:

1. Digital telephones for use as mini-master nurse-call stations.
2. Digital display shall indicate the call type, priority code, and calling station number of incoming calls.
3. Ring patterns shall be identical to those generated at the master station.
4. Capable of two-way communication with patient and staff stations and the master station, and other telephones interfaced with the system.
5. Capable of placing or answering outside calls when interfaced with the facility telephone system.
6. Capable of "All Call," group call, and staff call paging and of initiating service requests, logging calls to the reminder list, and activating optional door controls.

C. Third-Party Pocket Pager Interface:

1. Equipped with a standalone pocket pager interface.

2. Connects with the facility paging system and transmit alphanumeric messages to the pocket pagers as preprogrammed in the system.

D. Statistical Software:

1. Includes a data statistical software package that stores, sorts, and analyzes activities occurring on the nurse-call system network.
2. Windows based and operated on a PC that is connected to the nurse-call system network.
3. Stores events on the PC's hard disk. Accumulation of these stored events shall make up the database that is used to generate reports and statistics.
4. Events stored by the software shall include date, day of week, time, ward, priority, and room number.
5. Capable of assigning a patient name to bed number.
6. Stored events shall include, but not be limited to, calls placed, call priority, calls cancelled at the nurse station, calls cancelled at the point of origin, regenerated calls, calls answered, calls sent to pager interface, staff presence registration, staff presence cancellation, service request, service cancellation, and system and network error messages.

E. Data Analysis Software:

1. Capable of analyzing the stored information and generating computed analysis.
2. Analysis of the database can be conducted by specifying one, many, or all of the following parameters of the database: date, day of week, time, wards, priority, and room number.
3. Analysis shall include, but not be limited to, total number of calls placed, average call response time (from call placed to call cancellation), total number of presence registrations, average presence time in a room, total number of service requests, average response time (from audio answer to call cancellation), and average ring time (from call placed to audio answer).

F. Statistical Software Package:

1. Capable of displaying multiple calls/events on a PC monitor or on a RS-485 data-bus-driven digital display panel.
2. Calls from patient or staff stations and associated devices shall be displayed by priority. Display shall be customizable as follows:
   a. Choice of color by type of call.
   b. Choice of display size (character size).
   c. Choice of priority levels, type of events, points of origin.
   d. Identification of facility.
   e. Identification of ward.
   f. Identification of patient with specific patient information.

2.5 CONDUCTORS AND CABLES

A. Audio Cables:

1. Conductors: Jacketed, twisted-pair and twisted-multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.
2. Insulation: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
3. Shielding: For speaker/microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.

4. Minimum Shielding Coverage on Conductors: 60 percent.
5. Plenum Cable: Listed and labeled for plenum installation.

B. Data Cable and Hardware: Category 5e or Category 6 UTP and UTP hardware. Comply with additional requirements on Drawings.

C. Power Conductors and Cables: Copper, solid, No. 20 AWG. Comply with requirements in Division 26 "Low-Voltage Electrical Power Conductors and Cables."

D. Grounding Conductors and Cables: Copper, stranded, No. 16 AWG. Comply with requirements in Division 26 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wiring Method:

1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used.
   a. Install plenum cable in environmental air spaces, including plenum ceilings.
   b. Conceal raceway and cables except in unfinished spaces.
2. Cable Trays: Comply with requirements on Drawings.
3. Conduit and Boxes: Comply with requirements on Drawings.
   a. Outlet boxes shall be no smaller than 50 mm wide, 75 mm high, and 2-64 mm deep.

B. Install cables without damaging conductors, shield, or jacket.

C. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

E. Install exposed raceways and cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings designed and installed so as not to damage cables. Secure cable at intervals not exceeding 760 mm and not more than 150 mm from cabinets, boxes, or fittings.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Separation of Wires: Separate speaker/microphone, line-level, speaker-level, and power-wiring runs. Run in separate raceways or, if exposed or in same enclosure, provide 300-mm minimum separation between conductors to speaker/microphones and adjacent parallel power and telephone wiring. Provide separation as recommended by equipment manufacturer for other conductors.

H. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Install terminal cabinets where there are splices, taps, or terminations for eight or more conductors.

I. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks if required.

J. Identification of Conductors and Cables: Provide cable administration, cable schedule, and cable and wire identifications.

K. Equipment Identification:

1. Comply with requirements in Division 26 "Identification for Electrical Systems" for equipment labels and signs and labeling installation requirements.
2. Label stations, controls, and indications using approved consistent nomenclature.

3.2 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other signal impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding except at connection to main building ground bus.

C. Grounding Provisions: Refer to Drawings and Building code for requirements.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Schedule tests a minimum of seven days in advance.
2. Report: Submit a written record of test results.
3. Operational Test: Perform an operational system test and demonstrate proper operations, adjustment, and sensitivity of each station. Perform tests that include originating station-to-station and "All Call" messages and pages at each nurse-call station. Verify proper routing, volume levels, and freedom from noise and distortion. Test each available message path from each station on the system. Meet the following criteria:
   a. Speaker Output: 90 dB plus or minus 3 dB, 300 to 3000 Hz, reference level threshold of audibility 0 dB at 0.02 mPa of sound pressure.
   b. Gain from patient's bedside station to nurse station, with distortion less than 65 dB (plus or minus 3 dB, 300 to 3000 Hz).
   c. Signal-to-Noise Ratio: Hum and noise level at least 45 dB below full output.
4. Test Procedure:

   a. Frequency Response: Determine frequency response of two transmission paths by transmitting and recording audio tones.
   b. Signal-to-Noise Ratio: Measure the ratio of signal to noise of the complete system at normal gain settings using the following procedure: Disconnect a speaker/microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure the ratio of signal to noise and repeat the test for four speaker microphones.
   c. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 300, 400, 1000, and 3000 Hz into each nurse-call equipment amplifier, and measure the distortion in the amplifier output.

D. Retesting: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify, by the system test, that the total system meets these Specifications and complies with applicable standards. Report results in writing.

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

F. Prepare test and inspection reports.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sound levels and controls to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal operating hours for this purpose.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel and caregiver staff to adjust, operate, and maintain nurse-call equipment.

END OF SECTION 275223

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing site utilities.
7. Temporary erosion- and sedimentation-control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner or owners representative and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by the Owner or owners representative or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on the premises in location approved by the owner or owner’s representative.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to the Owner or Owners Representative.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by owner.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or owners representative or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify owners representative not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without owner representative's written permission.

C. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 20 centimeters, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 15 centimeters in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

D. Stockpile soil form Wetland in separate location from regular topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the Owner or Owners Representative's property.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner or Owners Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner or owners representative's Representative. Unauthorized excavation, as well as remedial work directed by Owner or Owners Representative, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

A. Preexcavation Conference: Conduct conference at Project Site.

1.4 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

B. Do not commence earth moving operations until plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: See Geotechnical Engineering Report

C. Unsatisfactory Soils: See Geotechnical Engineering Report

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 90 percent passing a 1-1/2-inch (40 mm) sieve and not more than 12 percent passing a No. 200 sieve.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; except with 100 percent passing a 1-inch (25 mm) sieve and not more than 8 percent passing a No. 200 sieve.

F. Drainage Course: Narrowly graded mixture of washed, crushed stone, or crushed or uncrushed gravel; with 100 percent passing a 1-1/2-inch (40 mm) sieve and 0 to 5 percent passing a No. 8 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (30 cm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (30 cm) each side of pipe or conduit

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (15 cm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (10 cm) deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Owner or Owners Representative, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Owner or Owners Representative.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owner or Owners Representative.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Roadways: Provide 10 cm thick, concrete-base slab support for piping or conduit less than 75 cm below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 10 cm of concrete before backfilling or placing roadway subbase course. Concrete is specified in concrete specifications.

D. Place and compact initial backfill of satisfactory soil, free of particles larger than 25 mm in any dimension, to a height of 30 cm over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 20 cm in loose depth for material compacted by heavy compaction equipment, and not more than 10 cm in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to the project geotechnical report:

1. Under structures, building slabs, or steps, scarify and recompact top 30 cm of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 15 cm below subgrade and compact each layer of backfill or fill soil material at 90 percent.
3. Under turf or unpaved areas, scarify and recompact top 15 cm below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial backfill soil according to number 1 and 2 above depending on location of utility trench.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 25 mm
2. Walks: Plus or minus 25 mm
3. Pavements: Plus or minus 15 mm

C. Grading inside Building Lines: Finish subgrade to a tolerance of 15 mm when tested with a straightedge.

3.14 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 15 cm in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 7.5 cm thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: A qualified geotechnical engineering testing agency shall be used to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Owner or Owners Representative.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off the Owner or Owners Representative's property.

3.18 SUBMITTALS

A. Work plan for removal and storage of materials to be approved by architect.

END OF SECTION 312000

SECTION 31 23 19 – DEWATERING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Control of groundwater and surface run-off for construction period.
2. Discharge of drainage water from construction site.
3. Coordinating dewatering work with requirements of other trades and units of work affected by dewatering operations.

1.02 DEFINITIONS

A. Subgrade: Surface to which excavations are necessarily made for the purpose of construction of the Work. Subgrade as defined does not include additional depths of excavation that may be required or ordered to obtain desired foundation conditions.

B. Performance Requirements

1. Install and operate dewatering systems, in coordination with the design and construction of excavation shoring systems, excavation and backfilling operations, to meet performance requirements.

2. Prevent surface run-off from entering excavations. Construct ditches, berms, and similar items as required to lead water away from excavation.

3. Do not allow silt laden run-off water to enter water courses. Direct runoff flows to siltation ponds or catchment areas.

4. Dewater and keep excavations free of water to permit placing geotexiles, granular filter blankets, underdrains, granular construction working surface, concrete, and similar items, on firm dry subgrade.

5. Maintain groundwater level a minimum of 12 inches below the subgrade or lower as may be required to fulfill the requirements of the specifications.

6. Prevent destabilization, heaving and shear failure of the bottom of excavation by depressurizing and dewatering groundwater.

7. Prevent damage to or displacement of structures from groundwater pressures.

8. Maintain groundwater a minimum of 12 inches below the subgrade until backfilling to final grade has been completed and underdrains and other permanent devices, which protect the structures against buoyancy, are operational. Where designed self-weight of structure resists the buoyancy forces, make sure that the structure is completely built before allowing groundwater level to rise.

9. Obtain the Design Engineer’s and the Authority’s written consent prior to allowing a rise in groundwater level or prior to shutting down the dewatering operation.

10. Repair or replace any structure or Works damaged due to dewatering.

B. Dewatering Discharge Requirements

1. Provide appropriate filter screens so that no soil or foundation material is removed.

2. Provide a discharge siltation pond, or similar method, of required size to allow sufficient detention time so that the decanted water will meet state regulations. Discharge water from run-off collection and dewatering operations to a siltation pond located on site as directed by the Engineer.

3. Maintain siltation pond during construction period by removing silt buildup from time to time to keep siltation pond functional.

4. The Authority may carry out chemical analysis of drainage water to establish conformance with state regulations. If required, treat the drainage water to meet the state regulation before discharging into a watercourse.

5. Discharge drainage water to existing water courses or storm drainage system. If discharging to water course, prevent erosion of existing banks.

1.04 SUBMITTALS

A. Shop Drawings

1. Submit a general plan of dewatering scheme which includes:

   a. Relationship between dewatering equipment, new structures, and the excavation plan.
   b. Location of dewatering discharge points.
   c. Location and dimensions of siltation pond.
   d. Details of screens and filter media.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Dewatering Equipment

1. Pipes, wells, deep wells, well points, pumps, electrical generators, and other equipment.

2. Standby pumps and a generator with effective muffling devices to keep noise levels to a minimum.

PART 3 – EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding areas.

2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.02 INSTALLATION

A. Install dewatering system utilizing infiltration trenches, wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material, valves, appurtenances, water disposal, and surface water controls.

B. Before excavation below ground water level, place system into operation to lower water to specified levels. Operate system continuously until sewers and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundation, sewer, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, sewers, and other excavations.

1. Maintain piezometric water level sufficiently below surface of excavation.

E. Dispose of water removed by dewatering in a manner that does not endanger public health, property, and portions of the work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow control devices as required.

F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional cost to Authority.

G. Remove dewatering system from site upon completion of dewatering. Plug or fill dewatering trenches and well holes with sand or cut off and cap wells a minimum of 36" below grade. Restore areas affected by dewatering system to original condition at no additional cost to Authority.

H. Damages: Promptly repair all damages to adjacent structures, property, and

END OF SECTION 312319

SECTION 312323 - FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Backfilling building perimeter to subgrade elevations.
   2. Backfilling site structures to subgrade elevations.
   3. Fill under slabs-on-grade.
   4. Fill under paving.
   5. Fill for over-excavation.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with Project Engineer and Geotechnical Engineer

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Subsoil fill material shall be a granular material approved by the Ministry of Public Works.

B. Materials brought for backfill or embankment (borrow) materials much be tested to determine if they are satisfactory by the Ministry of Public Works and/or the Project Geotechnical Engineer

PART 3 EXECUTION

3.1 BACKFILLING

A. Footings shall be backfilled and compacted to not less than 95% of its maximum unit weight in 9 inch layers. Each layer should be compacted as called for and each layer must be approved before another layer is placed.

B. Employ placement method that does not disturb or damage other work.

C. Maintain optimum moisture content of backfill materials to attain required compaction density.

D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft (3048 mm), unless noted otherwise.

E. Make gradual grade changes. Blend slope into level areas.

3.2 TOLERANCES

A. Top Surface of Backfilling: Plus or minus 25 mm from required elevations.

3.3 FIELD QUALITY CONTROL

A. Perform in place compaction tests in accordance with the following:
   1. Density Tests: As approved by the Ministry of Public Works
   2. Moisture Tests: As approved by the Ministry of Public Works.

B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.4 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 312500 - STABILIZATION METHODS FOR EROSION CONTROL

PART 1 - GENERAL

1.1 GENERAL

A. This section describes the following work:

1. Seed Application
2. Straw Mulch Application

B. The work schedule shall accommodate for installing permanent erosion control during the local region's seeding deadlines.

1.2 DEFINITIONS

A. Construction Period: Between the dates of Notice to Proceed and receiving the Notice of Termination or Acceptance of Work by the project manager.

B. Maintenance Period: Between the date of Notice to Proceed and Notice of Termination or Acceptance of Work

PART 2 - PRODUCTS

2.1 MATERIALS AND PROCEDURES

A. General: All materials and procedures required to achieve final surface stabilization shall meet the minimum criteria defined in the design plans, and the sections below.

B. Seed:

1. At least 60 days before seed application, submit proof that the order for seed required for the Contract has been placed and accepted by the seed vendor. Include the seed's botanical names, quantity ordered, and the anticipated date of delivery

2. Seeding rates should be based upon acceptable pure live seed (PLS) of 80%. When PLS is below 80%, adjust rates accordingly. To calculate the amount of seed to be applied:

a. Obtain the PLS factor by multiplying the seed label germination percentage by the seed label purity percentage

b. Divide the specified PLS rate by the PLS factor

3. Seed must not contain prohibited noxious weed seed or more than 1.0 percent total weed seed by weight.

4. Provide seed labels from the seed supplier that indicate:

a. Seed variety including botanical name and common name

b. Lot number or other lot identification

c. Origin

d. Net weight

e. Percent pure live seed

f. Percent total viability, which is equal to the sum of the percent germination, percent hard seed, and the percent dormant seed

g. Percent by weight inert matter

h. Percent by weight other crop seed

i. Percent by weight weed seed

j. Name of restricted noxious weed seed by number per pound of seed

k. Name and address of the supplier or grower responsible for the analysis

l. Deliver seed to the job site in unopened, separate containers/bags with the seed tag attached.

C. Straw Mulch

1. Straw shall be from native grass or rice.

2. Straw shall be furnished in air-dry condition with a consistency compatible for application with straw blowing equipment.

3. Straw shall be free of plastic, glass, metal, rocks, and refuse or other deleterious material.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

1. The sequencing of measures for final surface stabilization, as described in the plans, shall be adhered to.

2. Straw can be applied by hand or with a straw blower

3.2 SPECIFIC REQUIREMENTS

A. Seed

1. Application: Seeds shall be hand casted.

2. Inspection and Maintenance: Seeded slopes shall be inspected through the duration of the construction period. Slope surfaces shall be seeded if vegetation fails to establish, or coverage does not equal 90%. Re-seeding shall occur at the rate described in the plans.

B. Straw Mulch

1. Straw shall be applied approximately 75mm to 100mm thick. No soils should be visible after the straw mulch had been applied.

2. Straw shall be punched into the soil

a. On slopes with heavy equipment access, a spike roller shall be used to punch the straw into the soils. Straw shall be punched to a depth of 100mm.

b. On slopes without heavy equipment access, a spade or shovel may be used to punch handfuls of straw mulch into the soil. Hand punched straw shall be placed in a staggered pattern with straw placed at intervals as shown in the plans. Straw shall be punched to a depth of 100mm.

END OF SECTION 312500

SECTION 321200 - AGGREGATE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This work consists of furnishing, spreading, and compacting aggregate base. Place and compact aggregate paving at the locations and to the dimensions shown on the plans.

1.2 SUBMITTALS

A. Certificate of compliance from aggregate base supplier or other approved proof of compliance with contract requirements for aggregate base material.

B. Provide a sample of the material to confirm correct color and texture.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE

A. Aggregate base consistency shall be “dirty” with adequate fines for proper compaction and binding qualities. Rock shall be of angular shape, not rounded.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. Prior to installing the aggregate paving, areas to receive aggregate shall be shaped to reflect the same linear grade and cross slopes as the desired finished surface.

B. Subgrade surface shall be graded to within 15 mm of finish grade minus paving thickness.

C. The subgrade shall be uniformly smooth and compacted to meet or exceed 85% relative compaction, unless otherwise specified in the design plans.

D. Fill and compact any depressions and remove loose material to finish true to line and grade, presenting a smooth, compacted and unyielding surface except where indicated otherwise.

E. Remove debris, loose dirt and other extraneous materials.

F. If the subsurface soils have insufficient strength and cohesion to provide a stable base for the aggregate then a layer of non- woven geotextile fabric may be applied to the prepared area prior to the installation of the aggregate paving.

G. The project manager shall approve all staking prior to installation of aggregate paving.

3.2 INSTALLATION OF AGGREGATE PAVING

A. Uniformly spread aggregate smoothly over the prepared subgrade.

B. The aggregate shall be applied to the designated areas at a minimum total depth of 150 mm. The application shall be performed in two separate 75 mm lifts. The final lift shall be shaped and compacted to the proper lines, grades and slopes as shown on plans.

C. Compaction shall consist of a minimum four passes over the entire paved area for each lift. Compact aggregate material to a minimum 90% per unless otherwise specified in the project design plans.

D. Aggregate shall be kept moist to achieve maximum rate of compaction.

3.3 TOLERANCES

A. Finished surface smoothness: Maximum 75mm in 3 meters any direction

END OF SECTION

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
3. Job-Mix Designs: For each job mix proposed for the Work.

B. Material Certificates: For each paving material, signed by manufacturer.

C. Material Test Reports: For each paving material, by a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable local requirements of for asphalt paving work.

D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 15.6 deg C.
2. Tack Coat: Minimum surface temperature of 15.6 deg C.
3. Asphalt Base Course: Minimum surface temperature of 4.4 deg C and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 15.6 deg C at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

D. Mineral Filler: ASTM D 242/D 242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-2.

B. Asphalt Cement: ASTM D 946/D 946M for penetration-graded material.

C. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 300 mm into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.2 to 0.7 L/sq. m.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 25 mm in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 75 mm thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 6 mm.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use hot-applied joint sealant to seal cracks and joints more than 6 mm wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.7 to 2.3 L/sq. m. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.2 to 0.7 L/sq. m.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

B. Spread mix at a minimum temperature of 121 deg C.

1. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

C. Place paving in consecutive strips not less than 3 m wide unless infill edge strips of a lesser width are required.

D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 150 mm.
3. Offset transverse joints, in successive courses, a minimum of 600 mm.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt
5. Pavements."
6. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
7. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 85 deg C.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 or AASHTO T 245, but not less than 94 percent or greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 13 mm.
2. Surface Course: Plus 6 mm, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 3-m straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 6 mm.
2. Surface Course: 3 mm.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 836-sq. m or less of installed pavement, with no fewer than three cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

A. All excavated and demolished material shall be removed from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

C. Exposed Aggregate: 4.5-kg Sample of each mix.

D. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, strength, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Submit mix design from designated batch plant for each class of concrete for approval.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.

4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 2400 mm by 2400
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 4.4 deg C for oil-based materials for water-based materials, and not exceeding 35 deg C.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 30.5 m or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

C. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 82/A 82M.

I. Deformed-Steel Wire: ASTM A 496/A 496M.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.

K. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

M. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

N. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

Q. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, Type I or Type II, Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 19 mm nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 305 g/sq. m dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ChemMasters; Spray-Film.
b. Dayton Superior Corporation; Sure Film (J-74).
c. Euclid Chemical Company (The), an RPM company; Eucobar.
d. L&M Construction Chemicals, Inc.; E-CON.
e. Meadows, W. R., Inc.; EVAPRE.
f. Architect approved equal.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ChemMasters; Safe-Cure Clear.
b. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
c. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
d. L&M Construction Chemicals, Inc.; L&M CURE R.
e. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
f. Architect approved equal.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips. Coordinate final requirements with Architect for unit paving transitions.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 31 MPa.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 100 mm, plus or minus 25 mm.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 25-mm nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 30 and 32 deg C, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 32 deg C, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 0.76 cu. m or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 0.76 cu. m, increase mixing time by 15 seconds for each additional 0.76 cu. m.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 5 km/h.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 13.6 tonnes.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 13 mm according to requirements in "Earth Moving" specification.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 50-mm overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 38 mm into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 15.25 m unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 13 mm or more than 25 mm below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 10-mm radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3-mm wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 10-mm radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 4.4 deg C, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 10 deg C and not more than 27 deg C at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 32 deg C at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1.6 to 3 mm deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 1 kg/sq. m x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 300-mm lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 300 mm and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 19 mm.

2. Thickness: Plus 10 mm, minus 6 mm.
3. Surface: Gap below 3-m long, unleveled straightedge not to exceed 13 mm.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 13 mm per 300 mm of tie bar.
5. Lateral Alignment and Spacing of Dowels: 25 mm.
6. Vertical Alignment of Dowels: 6 mm.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 6 mm per 300 mm of dowel.
8. Joint Spacing: 75 mm.
9. Contraction Joint Depth: Plus 6 mm, no minus.
10. Joint Width: Plus 3 mm, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 76-cu. m or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 4.4 deg C and below and when it is 27 deg C and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 3.4 MPa.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete pavers set in aggregate setting beds.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.

1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be nonstaining to, installed pavers and other materials constituting paver installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Materials other than water and aggregates.
2. Pavers.
3. Edge restraints,
4. Precast concrete curbs.

B. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

C. Samples for Initial Selection:

1. Each type of unit paver indicated.
2. Joint materials involving color selection.
3. Exposed edge restraints involving color selection.
4. Precast concrete curbs.

D. Samples for Verification:

1. Full-size units of each type of unit paver indicated. Assemble not less than five Samples of each type of unit on suitable backing and grout joints.
2. Joint materials.
3. Exposed edge restraints, 304 mm in length.

4. One-quart #8, 57, aggregate, sealed in plastic bag, for openings in pavers for color verification.
5. One-quart sand for paver joints, sealed in plastic bag, for paver joints for color verification.
6. One 254 mm square sample geotextile.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site

1.6 DELIVERY, STORAGE, AND HANDLING

A. Any pavers delivered to site to be approved before and after unloading, unloading to be individually by hand or by pallet and fork lift to avoid breakage. No broken or uncured pavers will be accepted.

B. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store liquids in tightly closed containers protected from freezing.

F. Store asphalt cement and other bituminous materials in tightly closed containers.

1.7 PROJECT CONDITIONS

A. Curing: If unit paving is made on site, ensure availability of water during dry season for proper curing.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

A. Concrete Pavers: Solid paving units, locally sourced or site made units made from normal-weight concrete with a compressive strength not less than 41 MPa, water absorption not more

than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Solid units for pedestrian areas:

    a. Size: 60 mm thick, face size varies.
    b. Base: 30 mm sand bedding on 100 mm aggregate.

2. Permeable units for pedestrian areas:

    a. Size: 60 mm thick, size varies.
    b. Base: 40 mm #8 aggregate, on 100 mm #57 aggregate on 150 mm #2 stone subbase.
    c. Layout: Pavers arranged with gaps filled with #8 aggregate in gap.

3. Solid units for vehicular traffic areas:

    a. Size: 80 mm thick, size varies.
    b. Base: 30 mm sand bedding on 100 mm aggregate.

4. Color: As selected by Architect.

B. Molds Materials:

1. Molds: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, nonreactive with concrete and suitable for producing required finishes.

2.2 ACCESSORIES

A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II. Coordinate final requirements with Architect for vehicular paving transitions.

B. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

2.3 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 57.

B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 448 for Size No. 8.

C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D 448 for Size No. 10.

E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

1. Provide sand of color needed to produce required joint color.

F. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
2. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

G. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
2. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

H. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in "Earth Moving" specifications to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and or base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

1. For concrete pavers, a block splitter may be used.

D. Tolerances: Do not exceed 1.6-mm unit-to-unit offset from flush (lippage) nor 3 mm in 600 mm and 6 mm in 3 m from level, or indicated slope, for finished surface of paving.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 300 mm.

D. Place aggregate subbase and base, compact by tamping with plate vibrator, and screed to depth indicated.

E. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches 300 mm.

F. Place leveling course and screed to a thickness of 25 to 38 mm, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

G. Set pavers with a minimum joint width of 1.5 mm and a maximum of 3 mm, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 10 mm with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

H. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 16- to 22-kN compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

I. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

J. Do not allow traffic on installed pavers until sand has been vibrated into joints.

K. Repeat joint-filling process 30 days later.

END OF SECTION 321400

SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes wheel stops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sample: Provide site sample for Architect approval.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Any parking bumpers delivered to site to be approved before and after unloading, unloading to be individually by hand or by pallet and fork lift to avoid breakage. No broken parking bumpers will be accepted.

B. Store on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 27.6-MPa minimum compressive strength, 115 mm high by 225 mm wide by 1800 mm long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
2. Mounting Hardware: Hardware as standard with wheel-stop manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Install wheel stops in bed of adhesive before anchoring.

C. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 321713

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Painted markings applied to asphalt and concrete pavement.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

B. Submittal Drawings:

1. Show pavement marking configuration and dimensions. To include but not limited to:

a. At exit and entrance islands and turnouts.
b. On curbs.
c. At crosswalks.
d. At parking bays.

2. Show international symbol of accessibility at designated parking spaces.

C. Samples: For each exposed product and for each color and texture specified.

D. Certificates: Certify products comply with specifications.

E. Schedule: Coordinate final pavement marking operations with Architect.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Authorities having jurisdiction for pavement-marking work.

1.5 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, color, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.6 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight conditioned facility.

B. Protect products from damage during handling and construction operations.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 12.8 deg C for water-based materials, and not exceeding 35 deg C.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.

1. Colors: As selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Schedule: Coordinate final pavement marking operations with Architect.

B. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

C. Allow paving to age for a minimum of 30 days before starting pavement marking.

D. Sweep and clean surface to eliminate loose material and dust.

E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 0.4 mm.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

F. Provide dry time of paint per manufacturer's recommendations.

3.3 PROTECTING AND CLEANING

A. Clean spillage, splatters, drips and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

B. Repair damage.

C. Protect pavement markings from traffic and construction operations.

D. Protect newly painted markings from vehicular traffic until paint is dry and track free.

E. Place warning signs at beginning of wet line, and at points well in advance of marking equipment for alerting approaching traffic from both directions.

F. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.

END OF SECTION 321723

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications including all Division 01 Specification Sections, and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Results Includes

1. Custom fabricated decorative metal fence and gate fabricated from tubular architecturally exposed structural-steel (AESS) for posts, rails and miscellaneous frames.

a. Extruded steel louvered infill panels.
b. Manual swing gates and related hardware.
c. Miscellaneous attachments.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.4 ACTION SUBMITTALS

A. Product Data: Provide data on fence panels, posts, accessories, fittings and hardware.

B. Delegated-Design Submittal: For fence panels and post assembly indicated to comply with design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Employ a qualified and competent structural engineer to directly supervise all design and construction.

C. Shop Drawings: Show fabrication and installation details for support system.

1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, attachment details and schedule of components.

a. Indicate materials and profiles of each structure member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
b. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
c. Indicate exposed surfaces and edges and surface preparation being used.
d. Indicate special tolerances and erection requirements.

e. Infill panels.
f. Include plans, elevations, sections,
g. Show frame profiles, angles, and spacing.

D. Samples: Submit samples of fence panels, 457 mm by 457 mm in size illustrating construction and finish including the following:

1. Samples of AESS to set quality standards for exposed welds for Category 1 AESS.
2. Post, Brackets, & Sleeves: Two steel plates, 9 mm by 203 mm by 101 mm, with long edges joined by a groove weld and with weld ground smooth
3. Steel tube, minimum 203 mm, with end of another steel tube or pipe, approximately 203 mm, welded to its side at a 45-degree angle with a continuous fillet weld and with weld ground smooth and blended.
4. Samples of welded joints showing quality of workmanship and color matching of materials.

E. Manufacturer's Installation Instructions: Indicate installation requirements and post foundation anchor bolt templates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

C. Mock-Up: Provide a mock-up for evaluation of preparation techniques and installation workmanship.

1. Locate in areas designated by Architect.
2. Size: Minimum of 10 SF (1 m2).
3. Do not proceed with remaining work until workmanship is approved by Architect.
4. Rework mock-up as required to produce acceptable work.
5. Retain mock-up during construction as quality standard.
6. Remove and legally dispose of mock-up when no longer needed.
7. Incorporation: Incorporate mock-up into final construction.

D. Pre-installation Meetings: Conduct meetings including Contractor, Architect, fabricator, installer and other subcontractors whose work involves cable trellis system to verify project requirements, framing and support conditions, mounting surfaces and manufacturer's installation.

PART 2 - PRODUCTS

2.1 CUSTOM COMPONENTS

A. Frames and Posts: Cold-formed hollow structural sections, sizes as indicated on the drawings.

B. Infill Panels:

1. Vertical fixed louver bars: Formed steel louver shaped bars, 50 by 2 mm, spaced at 46 mm. Extend louver flange to allow 100 percent direct visual screening.
2. Cross Rods: Where required by design, 4 mm diameter rods welded perpendicular to back side of louver bars and spaced at 133 mm.
3. Perimeter side support bars: 51 by 6 mm flat bars.
4. Panel height: As indicated on Drawings.
5. Panel width: As indicated on Drawings.
6. Fasteners / Attachments: Wrought steel, forged steel, cast steel, or malleable iron.

C. Fence Height: As indicated on Drawings.

D. Swing Gate Configuration: As indicated.

1. Gate Frame Height: As indicated.
2. Gate Opening Width: As indicated.
3. Hardware:

a. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.

1) Function: 39 -Full surface, triple weight, antifriction bearing.
2) Material: Wrought steel, forged steel, cast steel, or malleable iron.

4. Finish exposed welds to comply shall be of good-quality, uniform undressed weld with minimal splatter.

E. Gate Egress Hardware: Swing as indicated, minimum three self-closing cam lift hinges per leaf, push pad rim type, exit only (without exterior trim), exit device suitable for exterior exposure and suitable for use as a code required egress.

2.2 MATERIALS

A. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing, sizes as indicated on the drawings.

B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

D. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11

E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 3, heavy-hex steel structural bolts; ASTM A 563, Grade C3, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

F. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

G. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

H. Concrete: Type specified in Section 033000 "Cast-In-Place Concrete; 2,500 psi strength at 28 days.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

C. Fasteners: Stainless steel tamper-resistant.

D. Intermediate Coats and Topcoats for Exterior Steel: Provide high performance top coats products that comply with Section 099000 "Painting."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.4 FABRICATION

A. Fit and shop assemble components in largest practical sizes for delivery to site.

B. Fabricate components with joints tightly fitted and secured.

C. Architecturally Exposed Structural-Steel (AESS):

1. In addition to special care used to handle and fabricate AESS, comply with the following:

    a. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
    b. Grind sheared, punched, and flame-cut edges of AESS to remove burrs and provide smooth surfaces and edges.
    c. Fabricate AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
    d. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.
    e. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
    f. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.

2. Provide weep holes where water may accumulate in AESS. Locate weep holes in inconspicuous locations.
3. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
4. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
5. Weld threaded nuts to framing and other specialty items indicated to receive other work
6. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.

a. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

D. Infill Louvers:

1. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
2. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

    a. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
    b. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.

3. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
4. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

    a. Frame Type: Channel unless otherwise indicated.

5. Include supports, anchorages, and accessories required for complete assembly.
6. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 1828 mm o.c., whichever is less.

    a. Semi recessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
    b. Exterior Corners: Prefabricated corner units with mitered and welded blades and with semi recessed mullions at corners.

7. Provide subsills made of same material as louvers or extended sills for recessed louvers.
8. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

G. Accommodate expansion and contraction of members without damage to connections or members.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL AND IRON FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. High Performance Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with high performance primers that comply with Division 09 "Painting."
2. Do not apply primer to galvanized surfaces.

D. Shop-Painted High Performance Finish: Comply with comply with Division 09 "Painting."

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and strip steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

C. Apply protective backing paint to metals in contact with cementitious materials or dissimilar metals.

3.3 INSTALLATION

A. Install fence, gates and louvers in accordance with manufacturer's instructions.

B. Installation AESS

1. General: Erect AESS true and plumb. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

    a. Handle and temporarily support AESS to prevent surface damage and other effects that might interfere with indicated finish.
    b. Set AESS accurately in locations and to elevations indicated.

2. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

    a. Do not use thermal cutting during erection unless approved by Architect.

3. Fitting: Fit members by cutting and restoring exposed surfaces to match specified surfacing.

    a. Predrill for fasteners using AESS connectors as templates.

4. Install AESS connectors as indicated.

    a. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

C. Set posts plumb. Set posts in concrete footings as indicated.

D. Louver Infill:

1. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
2. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
3. Form closely fitted joints with exposed connections accurately located and secured.

E. Install gate to gate posts level and plumb.

F. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.4 ADJUSTING

A. Test operable gates and adjust as needed to produce fully functioning units that comply with requirements.

B. Restore infill louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.5 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 6 mm.

B. Maximum Offset From True Position: 25 mm.

END OF SECTION 323119

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes planting soils and layered soil assemblies specified by composition of the mixes for protection and decompaction to 1 m minimum of any areas to be planted.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Provide products whether indicated or not for a complete installation as required but not limited to the following:

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment before delivery to the site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the Department of Agriculture and Food, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and any imported soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of soil scientist (CPSS) certified by SSSA under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.9 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."

4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 100 sq. m for 150-mm depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 100 sq. m for 6-150-mm depth of soil.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 6 to 7, a minimum of 6 percent organic material content; free of stones 25 mm or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

a. Surface soil may be supplemented with imported or manufactured topsoil from offsite sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 101 mm deep; do not obtain from agricultural land, bogs or marshes.

2.3 INORGANIC SOIL AMENDMENTS

A. General: Provide necessary inorganic soil amendments required to obtain a soil PH level of 6.0-7.0, and as required by each type of plant genus/species, based on soil testing reports.

B. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through 2.36-mm sieve and a minimum of 75 percent passing through 0.25-mm sieve.

2. Class: O, with a minimum of 95 percent passing through 2.36-mm sieve and a minimum of 55 percent passing through 0.25-mm sieve.
3. Provide lime in form of dolomitic limestone.

C. Aluminum Sulfate: Commercial grade, unadulterated.

D. Perlite: Horticultural perlite, soil amendment grade.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 19-mm sieve; soluble salt content of 5 Deci siemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source separated or compostable mixed solid waste.

B. Peat: The use of Sphagnum peat moss on this project is not acceptable. Use compost as specified herein for organic soil amendments, unless otherwise approved by the Architect.

C. Milorganite: The use of milorganite on this project is not acceptable.

2.5 PLANTING-SOIL MIX

A. Prior to soil preparation procedures provide a soil analysis completed by a reputable laboratory to determine any nutritional requirements and necessary pH and organic matter adjustments.

B. Once determined, the soil shall be appropriately amended to a range suitable for the tree, shrub and plant communities to be established.

C. Planting Soil Mix: Mix topsoil with the following soil amendments and fertilizers in the quantities complying with soil analysis:

1. Ratio of Loose Compost to Topsoil by Volume: 1:4, unless otherwise required per soil testing results.
2. Ratio of Loose Peat to Topsoil by Volume: As required to regulate soil PH, per soil testing results.
3. Weight of Lime: As required to regulate soil PH, per soil testing results Weight of Aluminum Sulfate: As required to regulate soil PH, per soil testing results.
4. Weight of Commercial Fertilizer: As required, per soil testing results.
5. Weight of Slow-Release Fertilizer: As required per soil testing results.

2.6 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance."

B. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.7 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 0.5 kg/100 sq. m of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 150 mm. Remove stones larger than 38 mm in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 50 mm of subgrade. Spread remainder of planting soil.

C. Application: Spread planting soil to total depth of 150 mm indicated on Drawings but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 200 mm in loose depth for material compacted by compaction equipment, and not more than 100 mm in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth indicated on Drawings. Remove stones larger than 38 mm in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.

D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix 100 mm of compost 150 mm of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on

laboratory testing according to ASTM D 698. Space tests at no less than one for each 100 sq. m of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.6 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.7 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Planting of trees, shrubs, flowering plants, coniferous trees, ornamental grasses and groundcovers.
2. Tree stabilization.
3. Edgings.
4. Maintenance.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with plastic or burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

F. Finish Grade: Elevation of finished surface of planting soil.

G. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

H. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

I. Planting Area: Areas to be planted.

J. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

K. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

M. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

N. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with Owner and Architect.

B. Coordinate protection of existing trees to remain as necessary during all planting and planting preparation activities. Refer to Division 01 Section “Temporary Tree and Plant Protection” for requirements.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. General: All submittals shall be approved by the Architect prior to commencement of the Work.

B. Samples for Verification:

1. Organic or Compost Mulch: 1-quart volume each of cotton burr mulch, pine bark mulch and pine straw organic mulches; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

2. Mineral Mulch: .90 kg of each mineral mulch locally, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
3. Weed Control Barrier: 304 mm by 304 mm.
4. Proprietary Root-Ball-Stabilization Device: One unit.
5. Slow-Release, Tree-Watering Device: One unit of each size
6. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
7. Pesticides.
8. Fertilizer.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Plant Selection Confirmation and Plant Sources List: Submit to the Architect and Owner for review and approval a list indicating the plant botanical and common name, size, quantity, form, root ball dimensions, limb height (if applicable), whether plant is a fall dig hazard, and source for the plants. Plant list shall clearly indicate any proposed deviations from the specified plant list and any proposed substitutions for approval.

1. Unavailability of Plant Material: Before changes or substitutions are made due to unavailability of plant material, the Contractor shall submit satisfactory evidence that he/she has been unable to locate the specified material and has undertaken all methods of locating plant material acceptable to the Owner and Architect.

D. Inspection Report: Request in writing the inspection of plant materials by the Architect and furnish complete information as to the location of all plants to be provided. Plants shall be subject to inspection and approval at place of growth for conformity to specification requirements. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the Work for size and condition of root balls and root systems, diseases, insects and latent defects or injuries. Rejected plants shall be removed immediately from the site.

E. Planting Schedule: Submit proposed planting schedule, indicating dates for each type of landscape or farming work during normal seasons for such Work in area of site. Correlate with specified maintenance periods to provide maintenance from date to Substantial Completion.

1. Once accepted, revise dates only as approved in writing, after documentation of causes of delays. Indicate dates for commencement and completion of the following operations:

a. Tagging of trees at nurseries.
b. Preparation of planting beds, infiltration basins, street tree pits, green roof and existing lawn areas for restoration.
c. Delivery of trees and other plant materials to site.
d. Planting of trees and other planting materials.

e. Completion of Work for commencement of warranty period.
f. Maintenance schedule and activities.

F. Maintenance Instructions: Submit typewritten instructions recommending procedures to be established by the Owner for future maintenance after acceptance and warranty expiration. Submit prior to expiration of required maintenance period(s). Recommendations shall include the following:

1. Application of anti-desiccant sprays.
2. Application of insecticides and fertilizers.
3. Maintenance of trees, shrubs, plants, meadow and ground covers.

G. Percolation test results.

H. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

I. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Planting installer qualifications: only a firm demonstrating a minimum of five years of experience, whose work has resulted in successful establishment of exterior plants similar to, or larger in size and scope than this project, shall be accepted.

B. Planting installer shall have on the project, at all times, a foreman knowledgeable in horticultural practice. Installer shall submit background history of foreman to the architect for approval.

C. All other installers shall be subject to the planting installer’s qualifications.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 150 mm above the root flare for trees up to 100-mm caliper size, and 300 mm above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size,

and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.10 Plant Selection Confirmation: Confirm all final plant selections and noted description for each as identified on the Plant Schedule, as well as source provider for each in written document with photographs submitted to the Architect prior to the final plant selection and tagging. Special attention to and acquisition of each specified plant cultivar/selection is required. Identify any plant material unavailable after thorough attempt to locate plant material specified as well as identify potential substitutions similar in type and scape specified. As necessary, the Owner and architect shall provide any required substitutions based on availability of alternative variety of comparable type, size, quantity and/or cost, or as otherwise approved by the Owner.

1. Perennial and grass cultivars with limited availability shall be contract grown. Provide coordination of contract growing lead time with overall Project schedule.
2. Confirm all final plant material selections and source providers prior to delivery so as not to cause delay of any kind to the scheduled timeline for plant delivery and installation.

B. Inspection: Architect and Owner's Representative will inspect plant materials at place of growth prior to planting execution for compliance with requirements for genus, species, variety, size and quality. Architect and Owner retain the right to inspect plant materials further for size and condition of root balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of the Work, even if previously inspected and approved.

1. Selection: All plants shall be tagged in the nursery by the Architect and Owner's Representative prior to digging of plants. The Architect and Owner's Representative shall place seals on selected plants at the nursery. Seals shall remain on plants until the acceptance of the Work. At least three weeks prior to expected planting date, request in writing the Architect's inspection of plant material at the nursery. Architect and Owner shall make their own travel arrangements.
2. Nursery Source: The Architect and Owner shall have the right to reject any nursery source if determined before, during or after inspecting or receipt of plants, any of the following:

    a. Stock does not meet quality standards set forth herein.
    b. Nursery stock does not meet the intended visual characteristics of the plants as determined by the Architect.
    c. Nursery cannot supply the specified plant(s) or an acceptable substitute cultivar or species.
    d. Nursery's cultural practices or maintenance procedures do not meet specified standards.
    e. Plants are infested with pests or disease.

C. Rejection of Materials:

1. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage shall be cause for rejection. Upon arrival at the temporary storage location or the site of the Work, plants shall be inspected for proper shipping procedures. Should the roots be dried out, large branches broken, root balls or earth broken or loosened, or areas of bark torn, the Architect or the Owner may reject the injured plant.

2. When a plant has been rejected, the Contractor shall at once remove it from the area of the Work and replace it with one of the required size, quality and visual compatibility with other identical specimens.

D. Plant Layout and Grading: After staking out the Work, and before commencement of final construction, obtain the Architect's approval for layout and grades.

1. 1. Stake out the Work in sufficient detail for evaluation by the Architect.
2. 2. Architect shall be present and assist with plant layout.
3. 3. Architect shall be permitted to make reasonable adjustments to layout and grading without further compensation to the Contractor.

E. Plant Sources: Submit to the Architect and Owner any questions regarding the source of any plant. Coordinate with Architect for final approved nursery sources.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 36 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 16 to 18 deg C until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.12 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: As determined by Architect.
2. Fall Planting: As determined by Architect.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements. Planting to occur during rainy season.

D. Water: On-site water shall be available for use in supplying all water for the Project as required.

1. Water connections available on site shall be reviewed with the Construction Manager. Immediately notify the Owner in writing if water is insufficient for Work and maintenance operations.
2. Provide as needed water from sources free from impurities injurious to vegetation.
3. Provide all hoses and equipment as needed to distribute water to area of landscape Work and areas needing watering. Water shall be from Owner’s source.

E. At Contractor’s expense, provide and maintain adequate connections, hoses, sprinklers, tree watering bags, and other necessary equipment and supplies with minimum leakage. Where use of hoses is not practical, water with a tank truck filled at Owner’s source. If project conditions preclude use of Owner’s water source, include cost of water from off-site source in base bid.

1. Provide, install and maintain slow release watering bags for all trees without supplemental irrigation. Secure bags as necessary for security. At end of maintenance contract period, leave bags in new condition for Owner’s use.

1.13 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
    b. Structural failures including plantings falling or blowing over.

2. Warranty Periods: From date of Substantial Completion.

    a. Trees, Vines, and Ornamental Grasses: 24 months.
    b. Ground Covers, Shrubs, Biennials, Perennials, and Other Plants: 12 months.
    c. Annuals: Three months.

3. Include the following remedial actions as a minimum:

    a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
    d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 19 mm in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 25-mm sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 38-by-38-mm actual by length indicated, pointed at one end.

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 38-by-38-mm actual by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

2.6 MISCELLANEOUS PRODUCTS

A. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

B. Planter Filter Fabric: Woven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

C. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prior to execution of planting Work, notify the Owner and Architect in writing of any existing site conditions considered to be detrimental to successful planting and growth of any plant material specified herein. In the event that obstructions are encountered obstructions shall be removed or plants relocated at no expense to the Owner, and as directed by the Architect.

B. Notify Architect at least (14) days prior to installation of plant material.

C. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

D. Layout and Approval: Layout and stake individual tree and shrub locations. Outline areas for other plantings as indicated on the Drawings. Obtain Architect's approval prior to commencement of installation. After staking layout has been accepted, set plants in place for final review and acceptance by the Architect prior to excavating and planting. Staking of plant locations for Architect's approval only after proper subgrade, drainage and subsoil layers have been installed and accepted. Make revisions and adjustments as directed by the Architect.

E. Percolation Testing: Percolation tests to be performed on a minimum of 10 percent of tree pits and 20 percent of shrub beds, including any areas of questionable drainage, or as required by the Architect. Percolation tests shall consist of one gallon container at minimum of 1 inch per hour drainage at base of plant root level.

F. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

G. Lay out individual tree, shrub, grass and flowering plant locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.

H. Lay out exterior plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

I. Trunk Wrapping: Where trunk wrapping is required, inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 50-mm caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.

J. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

K. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

L. Decompact all planting areas to minimum 1 m depth.

3.3 PLANTING BED ESTABLISHMENT

A. Planting Beds, General: Provide continuous planting beds for shrubs, grasses, flowering plants and groundcovers. Do not install shrubs, grasses, flowering plants and groundcovers in individual pits. Pre-review with the Architect areas where provision of continuous planting beds are not possible due to site restrictions.

B. Loosen subgrade of planting beds to a minimum depth of 203 mm. Remove stones larger than 25 mm in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

2. Spread planting soil mix to a minimum depth of 304 mm, but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 101 mm of subgrade. Spread remainder of planting soil mix.

C. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

D. Before planting, restore planting beds if eroded or otherwise disturbed after finish grading.

3.4 FINE GRADING

A. Prior to fine grading, verify that rough grading under drainage system, planting soil mixes and irrigation system have been accepted by the Architect.

B. Fine Grading: Set sufficient grade stakes for checking the finished grades. Stakes must be set at the bottom and top slopes and the centers of plant beds. Grades shall be established which are accurate to 1/10th of a foot in either direction. Connect contours and spot elevations with an even slope. All grading shall insure drainage away from structures.

1. After topsoil mix has been spread, it shall be carefully prepared by scarifying and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter, including stones over one inch in diameter shall be removed from the topsoil. Topsoil shall also be free of smaller stones in excessive quantities as determined by the Architect.
2. Fine grade planted areas to smooth, free draining, even surfaces with fine texture. Roll, rake and drag areas to flatten ridges and fill depression, except in select areas indicated on the Drawings. Control moisture content to maintain optimum conditions without creating muddy conditions.
3. Rolling, Typical: Roll the entire area with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depression caused by settlement of rolling shall be filled with additional topsoil and the surface shall be regraded and rolled until presenting a smooth and even finish to the required grade or to the shapes and configurations as indicated on the Drawings.
4. Maintenance and Restoration: Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to lawn planting.

3.5 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further

disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

2. Excavate at least 300 mm wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected after working hours
8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 150-mm diameter holes, 600 mm apart, into free-draining strata or to a depth of 3 m, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.6 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 50 mm above adjacent finish grades.

1. Backfill: Planting soil For trees, use excavated soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Prune only in the presence of Architect or Arborist.

B. Remove only dead, dying, or broken branches. Do not prune for shape.

1. For evergreen conifers, apply pruning sealant to primary cuts, exposed wood and adjacent bark according to pruning sealer manufacturer's written instructions.

C. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

3.8 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 50- through 125-mm caliper. Stake trees of less than 50-mm caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 450 mm below bottom of backfilled excavation and to extend at least 1830 mm or one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Upright Staking and Tying: Stake trees with two stakes for trees up to 3.6 m high and 63 mm or less in caliper; three stakes for trees less than 4.2 m high and up to 100 mm in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

1. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.9 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 1500 mm of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier vertically with bottom edge angled at 20 degrees away from the paving or other hardscape element, and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

3.10 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil or backfill.

C. Dig holes large enough to allow spreading of roots. For trees, dig holes at least 3 times the diameter of the root ball or container. For all other plants, dig holes at least 2 times the diameter of the root ball or container.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

3.12 PLANT MAINTENANCE

A. Maintenance shall begin immediately after each plant is installed and shall continue throughout the warranty period. Maintenance shall consist of pruning, re-fertilization, watering, weeding, mulching, tightening and repairing of guys and stakes, resetting plants to proper grades and upright positions and spraying.

B. Fill in as necessary any soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Prune periodically as necessary to remove dead or damaged branches.

D. Remove all weeds within the mulched area surrounding each plant. Under no circumstances are weeds and grass to be allowed to attain more than 4 inches of growth.

E. Restore mulch as necessary to preserve appearance and to control weed growth.

F. Water all plants once each week during the growing season or at a longer interval as directed by architect, once daily or as needed during dray season if planting is approved by the Architect. Water shall be applied slowly so as to penetrate the entire root zone.

G. Spraying shall be performed to control insects, fungus and other diseases, as necessary, or as approved by the Architect. Apply treatment as required to keep plant materials, planted areas and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

H. Maintenance inspection will be held at approximately 2-month intervals during the growing season after the beginning of the warranty period. Accompany the Architect and Owner during inspections.

I. Maintenance after initial acceptance, the date on which the warranty period begins, shall be the exclusive responsibility of the installer throughout the warranty period and shall follow the sequence of maintenance procedures indicated herein.

3.13 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

3.15 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.16 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of planting completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Six months from date of planting completion.

END OF SECTION 329300

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Dielectric fittings.
3. Sleeves.
4. Identification devices.
5. Grout.
6. Piping system common requirements.
7. Equipment installation common requirements.
8. Concrete bases.
9. Metal supports and anchorages.

1.2 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding to be approved by the Ministry of Public Works.

B. Steel Piping Welding to be approved by the Ministry of Public Works.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Hart Industries, International, Inc.
    e. Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Wilkins Div.
    g. Or Equivalent.

3. Description: Factory fabricated, union, NPS 2 and smaller.

    a. Pressure Rating: **150 psig minimum** at 180 deg F.
    b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Watts Water Technologies, Inc.
    e. Or Equivalent

3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.

    a. Pressure Rating: **150 psig minimum**.
    b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Calpico, Inc.
    b. Lochinvar Corporation.
    c. or Equivalent

3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.

    a. Pressure Rating: 300 psig at 225 deg F.
    b. End Connections: Threaded.

E. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Perfection Corporation.
    b. Precision Plumbing Products, Inc.
    c. Victaulic Company.
    d. Or equivalent.

3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

    a. Pressure Rating: [**300 psig at 225 deg F**].
    b. End Connections: Threaded or grooved.

2.3 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.4 IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

B. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

D. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

E. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

F. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

G. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

H. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, **polished brass**.
2. Material: 0.0375-inch- thick stainless steel.
3. Material: 3/32-inch- thick plastic laminate with 2 black surfaces and a white inner layer.
4. Material: Valve manufacturer's standard solid plastic.
5. Size: 1-1/2 inches in diameter, unless otherwise indicated.
6. Shape: As indicated for each piping system.

I. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.
2. NPS 2-1/2 and Larger: Dielectric flanges.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric couplings or dielectric nipples.
2. NPS 2-1/2 and Larger: Dielectric nipples.

3.2 PIPING INSTALLATION

A. Install piping according to the drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install piping to permit valve servicing.

D. Install piping at indicated slopes.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Select system components with pressure rating equal to or greater than system operating pressure.

H. Sleeves are not required for core-drilled holes.

I. Permanent sleeves are not required for holes formed by removable PE sleeves.

J. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

K. Verify final equipment locations for roughing-in.

L. Refer to equipment specifications in other Sections for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings per manufacturers recommendations.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.
5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.5 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.6 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Locate pipe markers on exposed piping according to the following:

    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    d. At manholes and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

3.9 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 331116 – SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

Work Included: The Work of this Section includes, but is not limited to the following: water-distribution piping and related components outside the building for water service and fire-service mains including:

1. Pipe and fittings.
2. Gate valves.
3. Ball valves.
4. Check Valves.
5. Air/Vacuum release valves.
6. Fire Hydrants
7. Valve boxes.
8. Tracer wire.
9. Warning tape.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of local utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with local requirements for materials, installations, tests, flushing, and valve and fire equipment supervision for fire-service-main piping for fire suppression.

D. Potable Water Compliance:

1. Comply with NSF 14 or equivalent local standards for plastic potable-water-service piping.
2. Comply with NSF 61 or equivalent local standards for materials for water-service piping and specialties for domestic water.

1.7 COORDINATION

A. Coordinate connection to water main with utility company or local authority.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by the Owners or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify the Owner's Representative no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without the Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. PVC pipe and fittings conforming to appropriate NSF requirements or approved equivalent local drinking water standards, such as Georg Fischer Harvel PVC pipe or approved equivalent.

1. PVC Fabricated Fittings: Conform to local drinking water standards and pressure rating of at least 100 psi.
2. PVC Molded Fittings: Conform to local drinking water standards and pressure rating of at least 100 psi.

2.2 JOINING MATERIALS

A. Conform to all applicable drinking water standards.

2.3 WATER METERS

A. Water meters will be furnished by local utility company or local authority.

2.4 BACKFLOW PREVENTERS

A. Backflow Preventers shall be manufactured by Watts or Febco or approved local equivalent that conforms to local standards.

2.5 WATER METER BOXES

A. Description: Water meter boxes shall conform to local standards.

2.6 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.7 BALL VALVES

A. Ball Valves shall conform to all applicable local drinking water standards, and shall be brass, such as those manufactured by Watts or approved equivalent.

B. Ball valves shall be used on pipe less than 50 mm diameter and shall match the size of the installed pipe.

C. Ball valves shall be full bore port ball type having a minimum working pressure of 200 psi.

D. Ball valves shall have bubble tight shut off.

2.8 CHECK VALVES

A. Check valves shall conform to all applicable local drinking water standards.

B. Check valves shall be swing-check style and approved for drinking water applications and rated up to 100 psig.

C. Check valves shall provide unrestricted flow (full flow body type) with a domed access cover and vent port.

D. The valve shall have the following materials:

1. Body, cover and disc: ductile iron
2. Exterior and interior coating: fusion bonded epoxy coating
3. Removable body seat: stainless steel
4. Resilient seat: Buna-N
5. Disc arm and external levers: ductile iron

2.9 FIRE HYDRANTS

A. Wharf Fire Hydrants:
   1. Manufacturers: Subject to compliance with local requirements, provide products by one of the following:

a. American AVK Co.; Valves & Fittings Div.
b. Jones, James Company.
c. McWane, Inc.; Clow Valve Co. Div. (Corona).
d. Mueller Co.; Water Products Div.
e. Approved Equivalent.

2. Description: Threaded 90 mm inlet with one 63.5 mm outlet. The wharf hydrant shall have a pentagon nut at top of spindle with no handle. Construct hydrant of all bronze. Connect hydrant to riser flange with a 127 mm long threaded brass nipple, regular wall thickness; and a ductile iron reducing threaded flange.
3. Minimum wharf hydrant standards shall include a brass head and valve with at least one 63.5 mm National Hose outlet supplied by a minimum 90 mm main and riser.
4. Height of the wharf hydrant at the centerline of the outlet shall be a minimum of 460 mm and a maximum of 1.2 m above the adjacent driving surface.
5. Wharf hydrants shall be maintained wet (full of water), and have a positive flow at all time.
6. Each hydrant/valve shall be identified with a reflectorized blue marker, with minimum dimensions of 76 mm, located on the fire hydrant riser.
7. Wharf hydrants are to be protected by boulders, bollards, or fencing. A 0.6 m clear space shall be maintained around the circumference of the hydrant.
8. Piping and appurtenances shall be minimum diameter of 90 mm.
9. Buried supply piping shall be a minimum nominal diameter of 90 mm and shall be of material approved for fire service piping (minimum Schedule 40 CPVC or ductile iron). CPVC fittings shall be not less than Schedule 80.
10. Aboveground piping and fittings shall be galvanized.
11. Riser and elbow shall be steel. Buried horizontal piping runs may be of an approved plastic pipe.
12. The wharf hydrant shall be hydrostatically tested for 300 psi at ambient temperature (21 deg C).

2.10 VALVE BOXES

A. Valve boxes shall be installed to protect all underground valves.

B. Valve boxes shall provide enough clearance within the box to allow for maintenance, repairs, and removal without removing the box.

2.11 TRACER WIRE

A. Tracer wire shall be installed with all buried plastic mains and services.

B. Tracer wire should be copper clad steel insulated wire.

2.12 WARNING TAPE

A. Warning tape shall be blue for water lines and green for sewer lines with utility labeled on the tape.

B. Warning tape shall be made of polyethylene and shall be a minimum 4 mm thick.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Locate all existing utilities before starting earthwork, excavation, and trenching.

B. Excavation, trenching, and backfilling are to be completed in conformance with local standards and requirements. See project excavation and/or earthwork specifications.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

D. Underground water-service piping 20 mm and larger shall be any of the following:

1. Soft copper tube; wrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
3. 90 mm and 150 mm: Sch. 40 PVC with a minimum pressure rating of 100 psi.

E. Aboveground and Vault Water-Service Piping shall be ductile iron.

F. Underground Fire-Service-Main Piping NPS 4 to NPS 8 shall be any of the following:

1. PE, minimum pressure rating of 100 psi, fire-service pipe; molded PE fittings; and heat-fusion joints.
2. PVC, minimum pressure rating of 100 psi, listed for fire-protection service; PVC minimum pressure rating of 100 psi, fabricated or molded fittings; and gasketed joints.

G. Aboveground Fire-Service-Main Piping shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for 76 mm and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for 50 mm and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, 76 mm and Larger: cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
2. Use the following for valves in vaults and aboveground:
   a. Gate Valves, 50 mm and Smaller: Bronze, nonrising or rising stem.

b. Gate Valves, 50 mm and Larger: cast iron, rising stem, resilient seated.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated

B. Install PVC in conformance with local requirements.

1. Install piping with 0.75 meter minimum cover unless otherwise specified on design plans. When 0.75 meter cover cannot be achieved, backfill trench with a 2-sack minimum flowable fill.

C. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

D. Sleeves shall be installed per piping manufacturer guidelines.

3.5 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. PVC Piping Gasketed Joints: Use joining materials according to local standards. Construct joints with elastomeric seals and lubricant according to local standards and manufacturer guidelines.

3.6 VALVE INSTALLATION

A. Install each underground valve with stem pointing up and with valve box.

B. Install as indicated and conforming to local requirements.

3.7 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's or local authorities written instructions.

B. Rough-in piping and specialties for water-meter installation according to utility company's or local authority’s instructions and requirements.

3.8 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

3.9 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 5cm above surface.

3.10 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wharf Fire Hydrants: Install 2.4 m from flammable vegetation, no closer than 1.2 m not further than 3.7 m from a roadway. Hydrant shall be installed a minimum of 15m and a maximum of 76 feet from any building it is to serve.

3.11 VALVE BOXES

A. Valve boxes shall be installed 25mm above surrounding grade.

B. Valve boxes installed in pavements and roads shall be installed flush with pavement surface.

3.12 TRACER WIRE

A. Tracer wire shall be laid within 150 mm of the pipe where practical and directly above if possible.

B. Tracer wire should never be wrapped around pipe or connectors except at the riser. Tracer wire should never be wrapped around polyethylene pipe or fittings.

3.13 WARNING TAPE

A. Warning tape shall be installed longitudinally above and centered on all pipes. The warning tape shall be installed continuous for the entire length of the pipe.

3.14 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig (0.35 MPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 MPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 liters per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

3.15 Prepare reports of testing activities

3.16 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel.

3.17 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described by local standards or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 331116

SECTION 331200 – WATER PUMP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Simplex, constant-speed self-priming centrifugal pumps.
2. Duplex, constant-speed self-priming centrifugal pumps.
3. Duplex, constant-speed vertical booster pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Pump stations shall withstand the effects of earthquake motions determined according to local standards.

1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the pump when subjected to the seismic forces specified by local standards.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For pumps. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For pumps, accessories, and components, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in local standards, by a qualified testing agency, and marked for intended location and application.

B. Code Compliance: Comply with local standards and codes for piping.

C. Pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SIMPLEX, CONSTANT-SPEED SELF-PRIMING CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with local requirements.

B. Description: Factory-assembled and -tested, fluid-handling system for domestic water, with pump, piping, valves, specialties, and mounted on base.

C. Wall-mountable control panel to be provided by manufacturer.

D. Pump: shall meet operating conditions indicated in the design plans. Contractor shall submit pumps for engineer's review and approval prior to installation.

E. Motor: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings, and directly mounted to pump casing. Select motor that will not overload through full range of pump performance curve.

F. Piping: Piping material shall be compatible with pump materials.

G. Valves:

1. Shutoff Valves 50mm and smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.
2. Shutoff Valves 75mm and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.
3. Check Valve 50mm and smaller: Silent or swing type in pump discharge piping.
4. Check Valve 75mm and Larger: Silent type in pump discharge piping.
5. Control Valve: Adjustable, automatic, pilot-operated or direct-acting, pressure-reducing type in pump discharge piping.
6. Control Valve: Combination adjustable, automatic, pilot-operated or direct-acting, pressure-reducing-and-check type in pump discharge piping.

H. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

I. Control Panel: simplex booster pump controls shall be integrated into a wall-mountable control panel included with the duplex self-priming centrifugal pumping system; automatic for single-pump, constant-speed operation, with load control and protection functions.

1. Control Logic: Electromechanical system with switches, relays and other devices in the controller.

2. Motor Controller: general-purpose, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.

   a. Control Voltage: To be determined, shall comply with the site electrical system, with integral control-power transformer.

3. Enclosure: Weather proof and Tamper proof
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Pump Operation: As described in the Design Plans – Water System Process Instrumentation Diagram and Narrative.

7. Instrumentation: Suction and discharge pressure gages.
8. Light: Running light for pump.
9. Thermal-bleed cutoff.
10. Water-storage-tank, low-level cutout.
11. High-suction-pressure cutout.
12. Low-discharge-pressure cutout.
13. High-discharge-pressure cutout.
14. Building Automation System Interface: Provide auxiliary contacts for interface to building automation system if provided.

    a. On-off status of pump.
    b. Alarm status.

J. Base: Structural steel.

K. Electrical Characteristics: To be determined, shall comply with the site electrical system, with integral control-power transformer.

2.2 DUPLEX, CONSTANT-SPEED SELF-PRIMING CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, fluid-handling system for water, with pumps, piping, valves, specialties, and controls, and mounted on base.

B. Pumps: shall meet operating conditions indicated in the design plans. Contractor shall submit pumps for engineer's review and approval prior to installation.

C. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings. Select motors that will not overload through full range of pump performance curve.

D. Piping: Shall be compatible with pump.

E. Valves:

1. Shutoff Valves 50mm and smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.
2. Shutoff Valves 75mm and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.
3. Check Valve 50mm and smaller: Silent or swing type in pump discharge piping.
4. Check Valve 75mm and Larger: Silent type in pump discharge piping.

5. Control Valve: Adjustable, automatic, pilot-operated or direct-acting, pressure-reducing type in pump discharge piping.
6. Control Valve: Combination adjustable, automatic, pilot-operated or direct-acting, pressure-reducing-and-check type in pump discharge piping.

F. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

G. Control Panel: Wall-mountable control panel supplied by manufacturer; automatic for multiple-pump, constant-speed operation, with load control and protection functions.

1. Control Logic: Electromechanical system with switches, relays and other devices in the controller.
2. Motor Controller: general-purpose, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.

    a. Control Voltage: To be determined, shall comply with the site electrical system, with integral control-power transformer.

3. Enclosure: Weather and Tamper Proof
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.

    a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.

6. Pump Operation and Sequencing: As described in the Design Plans – Water System Process Instrumentation Diagram and Narrative.

    a. Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.

7. Instrumentation: Suction and discharge pressure gages.
8. Lights: Running light for each pump.
9. Alarm Signal Device: Sounds alarm when backup pumps are operating.

    a. Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic reset.

10. Thermal-bleed cutoff.
11. Water-storage-tank, low-level cutout.
12. High-suction-pressure cutout.
13. Low-discharge-pressure cutout.
14. High-discharge-pressure cutout.
15. Building Automation System Interface: Provide auxiliary contacts for interface to building automation system if provided.

    a. On-off status of each pump.
    b. Alarm status.

H. Base: Structural steel.

I. Electrical Characteristics: To be determined, shall comply with the site electrical system, with integral control-power transformer.

2.3 DUPLEX, CONSTANT-SPEED VERTICAL BOOSTER PUMPS

A. Description: Factory-assembled and -tested, fluid-handling system for water, with pumps, piping, valves, specialties, and controls, and mounted on base.

B. Pumps: shall meet operating conditions indicated in the design plans. Contractor shall submit pumps for engineer's review and approval prior to installation.

C. Motors: Single speed, with grease-lubricated or pre-greased, permanently shielded, ball-type bearings. Select motors that will not overload through full range of pump performance curve.

D. Piping: Shall be compatible with pump.

E. Hydropneumatic Tank (Pressure Tank): Precharged diaphragm or bladder tank made of materials complying with drinking water standards.

a. Minimum Water Volume: 2000 L.
b. Maximum Pressure: 7 Bar

F. Valves:

1. Shutoff Valves 50mm and smaller: Gate valve or two-piece, full-port ball valve, in pump suction and discharge piping.
2. Shutoff Valves 75mm and Larger: Gate valve or lug-type butterfly valve, in pump suction and discharge piping.
3. Check Valve 50mm and smaller: Silent or swing type in pump discharge piping.
4. Check Valve 75mm and Larger: Silent type in pump discharge piping.
5. Control Valve: Adjustable, automatic, pilot-operated or direct-acting, pressure-reducing type in pump discharge piping.
6. Control Valve: Combination adjustable, automatic, pilot-operated or direct-acting, pressure-reducing-and-check type in pump discharge piping.

G. Dielectric Fittings: With insulating material isolating joined dissimilar metals.

H. Control Panel: Wall-mountable control panel supplied by manufacturer; automatic for multiple-pump, constant-speed operation, with load control and protection functions.

1. Control Logic: Electromechanical system with switches, relays and other devices in the controller.
2. Motor Controller: general-purpose, full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.

a. Control Voltage: To be determined, shall comply with the site electrical system, with integral control-power transformer.

3. Enclosure: Weather and Tamper Proof
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.

a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.

6. Pump Operation and Sequencing: As described in the Design Plans – Water System Process Instrumentation Diagram and Narrative.

7. Instrumentation: Suction and discharge pressure gages.
8. Lights: Running light for each pump.
9. Alarm Signal Device: Sounds alarm when backup pumps are operating.

    a. Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic reset.

10. Thermal-bleed cutoff.
11. Water-storage-tank, low-level cutout.
12. High-suction-pressure cutout.
13. Low-discharge-pressure cutout.
14. High-discharge-pressure cutout.
15. Building Automation System Interface: Provide auxiliary contacts for interface to building automation system if provided.

    a. On-off status of each pump.
    b. Alarm status.

I. Base: Structural steel.

J. Electrical Characteristics: To be determined, shall comply with the site electrical system, with integral control-power transformer.

2.4 MOTORS

A. Comply with local standards in design designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in local standards.

2.5 PUMPHOUSE SHED AND FOUNDATION

A. General: Form pumphouse shed and foundation to dimensions indicated on the design plans.

B. Cast-in-place concrete according to local standards and requirements, and the following:

1. Cement: Type II Portland Cement or equivalent
2. Fine Aggregate: Sand; Conforms to local requirements.
3. Coarse Aggregate: Crushed Gravel; Conforms to local requirements.
4. Water: Potable.

C. Cement Design Mix: 20 MPa minimum, with 0.4 maximum water/ cementitious materials ratio.

1. Reinforcing Fabric: Conform to local requirements; steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615M, Grade 420 deformed steel or local equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install self-priming centrifugal pumps and vertical booster pumps on cast-in-place concrete equipment base(s) in pumphouse or in water treatment room as specified on the plans. Comply with requirements for equipment bases and foundations specified in local standards
2. Comply with requirements for vibration isolation and seismic control devices specified in local standards.

B. Support connected water piping so weight of piping is not supported by booster pumps.

C. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 331116 "Site Water Utility Distribution Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect raw water piping to suction of simplex self-priming centrifugal pumps. Connect fire water piping to discharge of simplex self-priming centrifugal pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly, or gate valves same size as suction and discharge piping.
2. Install union, flanged, or grooved-joint connections on suction and discharge piping at connection to domestic-water piping.
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge piping.
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge piping.
5. Install piping adjacent to booster pumps to allow service and maintenance.

C. Connect raw water piping to duplex self-priming centrifugal pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly, or gate valves same size as suction and discharge piping.
2. Install union, flanged, or grooved-joint connections on suction and discharge piping at connection to domestic-water piping.
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge piping.
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge piping.
5. Install piping adjacent to booster pumps to allow service and maintenance.

D. Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge piping. Install ball, butterfly, or gate valves same size as suction and discharge piping.
2. Install union, flanged, or grooved-joint connections on suction and discharge piping at connection to domestic-water piping.
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge piping.
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge piping.
5. Install piping adjacent to booster pumps to allow service and maintenance.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in local standards.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION 331200

SECTION 331619 - WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Domestic (Potable) Water Tanks

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: All project water storage tanks, including structural reinforcement and foundation, shall be capable of withstanding the effects of dead and live gravity loads and wind loads.

B. Seismic Performance: All project water storage tanks, including structural reinforcement and foundation, shall be capable of withstanding the effects of earthquake motions determined according to authorities having jurisdiction.

C. Thermal Movements: All project water storage tanks, including structural reinforcement and foundation, shall allow for thermal movements resulting from the maximum change in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, accessories, appurtenances, and furnished specialties for each water storage tank indicated in the design plans.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details for each surface water-storage tank, including the following:

1. Tank, roof, and shell openings.
2. Safety railings and ladders.
3. Plans, elevations, sections, details, and attachments to other work.
4. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
5. Power, signal, and control wiring (if required).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Bacteriological test results.

C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Obstruction lighting.
2. Lightning protection.
3. Cathodic protection.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employ a qualified structural engineer to prepare calculations, Shop Drawings, and other structural data for fabrication and erection of surface water-storage tanks.

1. Engineering Responsibility: Preparation of data for water storage tanks, accessories, specified appurtenances, and concrete supports and foundations, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Welding: Qualify procedures and personnel according to local standards and requirements.

C. Pipe Welding: Qualify procedures and personnel according to local standards.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in local standards by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CONCRETE WATER STORAGE TANKS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work shall be approved by the project engineer.

B. Water tanks shall be constructed of concrete or project manager approved equivalent material, and shall be of the size, capacity, dimensions, and location presented on the design plans (dimensions specified in design plans).

1. Each water tank shall be designed for underground installation, and shall be able to withstand earth pressures and traffic loading.

2. A traffic-rated concrete manway (with dimensions as shown on the design plans) and steel tamperproof cover shall be installed to provide access and maintenance to each tank.

3. Each water tank shall be equipped with a mechanical float valve designed and installed to prevent overflow of the tank.

C. Tank Capacity: As shown on design plans

D. Tank Height: As shown on design plans

E. Tank Wall Diameter: As shown on design plans

F. Reinforcing Steel: Grade 60, zinc-coated billet steel bars or approved local equivalent.

G. Waterstops: Ribbed, PVC

H. Bearing Pads: Located under walls and roofs

I. Bolts, Nuts, Washers, and Expansion Sleeve Inserts: Stainless steel.

J. Tank Vents: Shall include a screen, constructed to prevent entrance of rain, insects**,** birds, and animals.

K. Tank Interior Surface Sealer: Cementitious coating modified with acrylic or styrene-acrylic based polymer or approved equivalent.

2.2 WATER STORAGE TANK APPURTENANCES

A. Water-Level Controls: Indicators for maintaining water level in tank shall be provided for the following conditions:

1. High- and low-water levels.
2. Tank overflowing or tank not filling.

B. Obstruction Lighting: Comply with requirements of authorities having jurisdiction.

A. Lightning Protection: Comply with requirements of authorities having jurisdiction.

B. Cathodic Protection: Comply with local requirements.

PART 3 - EXECUTION

3.1 WATER STORAGE TANK INSTALLATION

A. Tank Walls: Construct tank wall and install accessories and appurtenances according to local standards.

B. Floor: Reinforced, cast-in-place concrete. Pour monolithically without cold joints and provide mechanical float finish.

C. Install construction and maintenance hatch near ladder.

D. Access lid(s) shall be installed 5cm above grade in landscaped areas.

3.2 CONNECTIONS

A. Connect tanks to water-distribution piping.

B. Connect drains to storm-drainage piping.

C. Ground equipment according to local standards.

D. Connect wiring according to local standards.

3.3 SURFACE WATER-STORAGE TANK APPURTENANCE INSTALLATION

A. Install and adjust water-level control valves, piping, and any alarms.

B. Install obstruction lighting according to authorities having jurisdiction.

C. Install lightning protection according to local standards.

3.4 FIELD QUALITY CONTROL

A. Testing: The Contractor will engage a qualified testing agency to perform the following field quality-control testing:

1. Leak Test: Comply with local standards. Fill tanks with potable water and test for leaks after installation. Repair leaks and retest until no leaks exist.

a. Water will be furnished by the owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 CLEANING

A. Clean interior and exterior of water storage tanks.

B. Disinfect surface water storage tanks according to requirements of authorities having jurisdiction.

END OF SECTION 33619

SECTION 333100 – UTILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Pipe and fittings.
2. Ball valves.
3. Check valves.
4. Air release valve.
5. Non-pressure and pressure couplings.
6. Cleanouts.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 10 bar.

1.4 SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. All pipe and pipe fittings shall meet all applicable material and installation standards.

B. All pipe fittings shall be of similar and compatible material as the pipe used.

C. All pipe, fittings, and joints shall be material intended for the proposed use.

D. All finished and installed joints and fittings shall be water tight.

E. PVC Type PSM Sewer Piping:

1. Pipe: SDR 35 PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints, such as JM Eagle Ring-Tite Pipe or Approved Equivalent.
2. Fittings: PVC with bell ends. All fittings shall be soil and water tight.
3. Gaskets: elastomeric seals.

F. HDPE Sewer Force Main Piping:

1. Pipe: HDPE sewer force main piping; FMG approved, with minimum thickness equivalent to FMG Class 150.
2. Fittings: PE resin, socket- or butt-fusion type, made to match HDPE pipe dimensions and class.

2.2 BALL VALVES

A. Ball valves shall be approved for wastewater applications.

B. Ball valves shall be full bore port ball type having a minimum working pressure of 14 bar.

C. Ball valves shall have bubble tight shut off.

D. Ball valves 3 inches and under shall be PVC and have the following materials:

1. Body, Ball, and Stem: Type 1, Grade 1 PVC
2. Union end connections
3. Reversible Teflon valve seats with Viton-A O-ring stem seal or PTFE seat with EPDM O-ring,
4. Available Manufacturers:
   a. Hayward
   b. Milwaukee Valve
   c. Nibco
   d. Approved equivalent.

E. Ball valves 4 inches and larger shall have the following materials:

1. Body: Cast iron; Three-piece design O-ring sealed.
2. Ball: Cast Iron; Full port, Type 316 stainless steel seating surfaces mating with rubber seating rings in the body end-pieces.
3. Body seats: Buna-N secured to the body end-pieces by epoxy retainers injected in place in dovetail grooves.
4. Shafts: Two piece stub type; 18-8 Type 304 stainless steel.
5. Bearings: Teflon-lined with fiberglass backing.
6. Operators: manual compound lever traveling nut type with handwheel.
7. Available Manufacturers:
   a. Apollo
   b. Henry Pratt Company
   c. Milwaukee Valve
   d. Nibco
   e. Approved equivalent.

2.3 CHECK VALVES

A. Check valves shall be swing-check style and approved for wastewater applications and rated up to 10 bar.

B. Check valves shall provide unrestricted flow (full flow body type) with a domed access cover and vent port.

C. The valve shall have the following materials:

1. Body, cover and disc: ductile iron, Grade 65-45-12
2. Exterior and interior coating: approved fusion bonded epoxy coating
3. Removable body seat: stainless steel, Type 304
4. Resilient seat: Buna-N
5. Disc arm and external levers: ductile iron, Grade 65-45-12

2.4 AIR RELEASE VALVES

A. The air release valve shall be suitable for wastewater applications. The air release valve shall be equipped with a back-flushing system (shutoff valve, fittings, and a rubber hose).

B. The air release valve shall be installed at the high point in the piping system as shown on the plans.

C. If the finished grade elevations changed during construction from that shown on the drawings, valve assemblies shall be installed at the high point(s) in the line as constructed.

D. The valves shall have an extended body to keep material away from the operating mechanism.

E. The valves shall have full size NPT inlets and outlets equal to the nominal valve size. The body shall have 2" NPT cleanout and 1" NPT drain connection on the sides of the casting. The cover shall be bolted to the valve body and sealed with a flat gasket. A threaded adjustable orifice button shall provide drop tight shut off to the full valve pressure rating.

F. Floats shall be unconditionally guaranteed against failure include pressure surges. Extended mechanical linkage shall provide suitable mechanical advantage so that the valve will open under full operating pressure.

G. The valve shall be constructed of the following materials:

1. Valve Body and Cover: cast iron
2. Orifice, float, and linkage mechanism: stainless steel, Type 316
3. Orifice button: Buna-N.

H. Available manufacturers:

1. APCO
2. Cla-Val
3. Flomatic
4. Val-matic
5. Approved Equivalent

2.5 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: elastomeric seal, PVC.
2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.6 CLEANOUTS

A. Cleanouts shall be PVC pipe and shall be the same size as the line on which they are installed. Cleanouts shall be located as shown in the plans. Cleanouts shall be installed on the gravity and forced main sewer lines. The cleanouts will be either standard one-way cleanouts or two-way cleanouts as indicated on the layout.

B. Cleanouts shall generally conform to the dimensions and materials presented in the design plans.

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
2. Top-Loading Classification: Heavy Duty where traffic is anticipated. Light Duty is acceptable where traffic is not anticipated
3. Traffic-rated box shall be Oldcastle Precast Christy Box or Approved Equivalent.

2.7 DETECTABLE WARNING TAPE

A. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

2.8 CONCRETE

A. General: Cast-in-place concrete complying with following:

1. Cement: Type II Portland Cement or equivalent
2. Fine Aggregate: Sand; Conforms to local requirements.
3. Coarse Aggregate: Crushed Gravel; Conforms to local requirements.
4. Water: Potable.

B. Portland Cement Design Mix: 20 MPa minimum, with 0.4 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: welded wire fabric, plain.
2. Reinforcing Bars: 420 MPa deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 20 MPa minimum, with 0.4 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: steel, welded wire fabric, plain.
2. Reinforcing Bars: 420 MPa deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Locate all existing utilities before starting earthwork, excavation, and trenching.

B. Excavation, trenching, and backfilling are to be completed in conformance with local standards and requirements. See project excavation and/or earthwork specifications.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout shall take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install cleanouts for all changes in horizontal and vertical direction and at a maximum spacing of 30 meters. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.
2. Install piping with 0.75 meter minimum cover unless otherwise specified on the design plans. When 0.75 meter cover cannot be achieved, backfill trench with a 2-sack minimum flowable fill.
3. Install PVC sewer piping according to local standards and requirements.

G. Clear interior of piping of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure sewer piping according to the following:

1. Join PVC sewer piping according to local standards.

B. Pipe couplings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. Unshielded flexible couplings for pipes of same or slightly different OD.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts where traffic is anticipated.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 CONNECTIONS

A. Connect nonpressure, gravity-flow sewer piping to building's sanitary building drains specified in project design plans.

3.6 IDENTIFICATION

A. Arrange for installation of warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to local standards.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 60 cm of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 3 meters head of water, and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with water.

END OF SECTION 333100

SECTION 333216 – UTILITY SANITARY SEWERAGE PUMP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Pump tanks.
2. Submersible pump systems.
3. Self-priming centrifugal pump systems.
4. Pump system control panels

1.3 ACTION SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show equipment sizes, locations, and elevations. Show control panel layout.

B. Product Data: Include material descriptions, rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

C. Shop Drawings:

1. Include manhole openings, covers, pipe connections, and accessories.
2. Include piping with sizes and invert elevations.
3. Include underground structures.
4. Include other utilities.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in local standards, by a qualified testing agency, and marked for intended location and application.

B. Code Compliance: Comply with local standards and codes for piping.

C. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 CONCRETE OR CONCRETE MASONARY UNIT (CMU) PUMP TANKS

A. Design: For traffic loading according to local standards.

B. Manholes: 600mm x 600mm minimum square opening or 600mm minimum diameter opening with reinforced-concrete risers to grade and access lid with steel lift rings. Openings shall be a minimum of 750mm x 750mm square or 750mm diameter over submersible pump systems. Position manholes to allow access to inlet, outlet, and submersible pump system.

C. Inlet and Outlet Access: Include access centered over inlet, outlet, and to allow access to submersible pump systems.

D. Resilient Connectors: Size required for piping, fitted into inlet and outlet openings, and baffle openings.

E. Capacity and Characteristics:

1. Capacity: As shown in design plans.
2. Inlet and Outlet Size: As shown in the design plans.

2.2 SUBMERSIBLE PUMP SYSTEMS

A. Submersible, Fixed-Position, Single-Seal Sewage Pumps:

1. Sewage pumps for all lift stations shall be identical.
2. Manufacturers: As identified in Design Plans or approved equivalent.
3. Description: Factory-assembled and factory-tested sewage-pump unit.
4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump.
5. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
6. Impeller: Statically and dynamically balanced, cast iron, cast bronze and stainless steel, non-clog, open, or semi-open design for solids handling, and keyed and secured to shaft.
7. Pump and Motor Shaft: Stainless steel with factory-sealed, grease-lubricated ball bearings.
8. Seal: Mechanical.
9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
    a. Motor Housing Fluid: Oil.

B. Pump Capacities and Characteristics: As identified in Design Plans.

2.3 SELF-PRIMING CENTRIFUGAL PUMP SYSTEMS

A. Self-priming, centrifugal pumps:

1. Pumps for all wastewater treatment systems shall be identical.
2. Manufacturers: As identified in Design Plans or approved equivalent.
3. Description: Factory-assembled and factory-tested self-priming pump unit.
4. Pump Type: applicable for wastewater processing. The pumps shall have self-cleaning clog resistant impellers capable of handling 10mm semi solids. Self-priming to 6 m.
5. Pump Materials: Cast iron construction with Buna-N Seals.
6. Motor: NEMA 56J Motor with stainless steel shaft.

B. Pump Capacities and Characteristics: As identified in Design Plans.

2.4 PUMP SYSTEM CONTROL PANELS

A. Control Sequence of Operation: As described in design drawings, specifically the Process Instrumentation Drawing (PID).

B. Float-Switch System: Senses variations of sewage level in tanks. Include high and low adjustments capable of operating on 15 cm minimum differential of liquid level.

C. Motor Controllers: Magnetic, full voltage, non-reversing. Include undervoltage release, thermal-overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.

1. Motor contactors shall be rated for 240V and 2.5 million cycles at pump Full Load Amperage
2. Provide one hand/off/auto switch per pump
3. Provide one run time meter per pump
4. Provide one cycle counter per pump

D. Programmable Logic Controller

1. Analog and digital input and output as required
2. Input and output expansion capacity: additional 20%
3. 300 Mhz cpu, 32 bit, x-86 with integrated timer
4. 128 mb RAM, 32 kb FRAM,
5. 512 MB IDE Flash Disk storage (upgradable to 2 gb)
6. 4 USB 2.0 host ports
7. 4 Serial ports
8. 10/100 Ethernet with standard TCP/IP Protocols
9. Built in UPS, Batery Charger, and power management
10. Telephone modem

E. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.

F. Control Panel: Enclosure complying with UL 508A. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

1. Mounting: Inside, on dry-chamber wall
2. Enclosure: NEMA 250, Type 1

G. Install labels on panel face to identify switches and controls.

H. Wiring: Tin-copper wiring.

I. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by separate level-detecting device. Include alarm silencer switch and relay in station.

J. Remote Alarm Circuit: Include contacts for connection to remote alarm panel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling

1. Stockpile topsoil for reuse in finish grading without intermixing with other excavated material. Stockpile materials away from edge of excavation and do not store within drip line of remaining trees.
2. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

B. Excavating and Backfilling for Pump Tanks:

1. Excavate sufficient width and length for tanks to depth determined by tank inlet elevation. Provide level bottom.
2. Backfill with excavated soil, mounding soil above original grade without compacting.

3.2 PUMP TANK INSTALLATION

A. Install Pump Tanks according to local standards.

B. Install Pump Tanks level.

C. Connect Pump Tanks to concrete ballast pad.

D. Waterproof all sections of each Pump Tank.

E. Fill Pump Tanks with water and test for water tightness (see field quality control section below).

3.3 INSTALLATION

A. Pump Installation Standard: Comply with manufacturer information for installation of pump systems.

B. Splice Boxes: Splice boxes shall be installed as shown of the Design Plans.

C. Equipment Mounting:

1. Install at-grade self-priming pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in local standards
2. Comply with requirements for vibration isolation and seismic control devices specified in local standards.

D. Support connected piping so weight of piping is not supported by pumps.

E. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing sewage pumping systems and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Pumps and controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

E. Remove and replace pumping systems that do not pass tests and inspections and retest as specified above.

F. Additional Tests: Fill Pump Tanks with water and let stand overnight. If water level recedes, locate and repair leaks and retest. Repeat tests and repairs until no leaks exist.

3.5 STARTUP SERVICE

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Adjust pump, accessory, and control settings, and safety and alarm devices.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain pump systems.

END OF SECTION 333216

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Channel drainage systems.
3. Encasement for piping.
4. Manholes.
5. Cleanouts.
6. Non-pressure transition couplings.
7. Expansion joints.
8. Catch basins.
9. Stormwater inlets.
10. Pipe outlets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

PART 2 - PRODUCTS

A. Corrugated PE Pipe and Fittings as approved by the Ministry of Public Works.

2.2 PVC PIPE AND FITTINGS

A. PVC Corrugated Sewer Piping as approved by the Ministry of Public Works.

2.3 CONCRETE PIPE AND FITTINGS

A. Non-reinforced-Concrete Sewer Pipe and Fittings as approved by the Ministry of Public Works.

B. Reinforced-Concrete Sewer Pipe and Fittings as approved by the Ministry of Public Works.

2.4 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 MANHOLES

A. Standard Precast Concrete Manholes as approved by the Ministry of Public Works.
   1. Diameter: 120 cm (48 inches) minimum unless otherwise indicated.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
   3. Base Section: 15 cm (6-inch) minimum thickness for floor slab and 10 cm (4-inch) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   4. Riser Sections: 10 cm (4-inch) minimum thickness, and lengths to provide depth indicated.
   5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
   6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
   7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   8. Steps: Deformed, 12 mm (1/2-inch) steel reinforcing rods wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 30 to 40 cm (12- to 16-inch) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 1.5 meters.
   9. Grade Rings: Reinforced-concrete rings, 15 to 22.5 cm (6- to 9-inch) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

   1. Description: Ferrous;60 cm (24-inch ID) by 18 to 22.5 cm (7- to 9-inch) riser with 100 mm (4-inch-) minimum width flange and 66 mm (26-inch-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.6 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

   1. Cement: ASTM C 150, Type II.
   2. Fine Aggregate: ASTM C 33, sand.
   3. Coarse Aggregate: ASTM C 33, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

   1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

E. Drainage Specialties: Precast concrete units.

1. Large Catch Basins:

a. 60- by-30 cm (24-by-12-inch) concrete body, with outlets in quantities and sizes indicated.
b. Gray-iron slotted grate.
c. Frame: Include gray-iron or steel frame for grate.

2. Small Catch Basins:

a. 50-by-60 cm (19- to 24-inch) by approximately 15 cm (6-inch) concrete body, with outlets in quantities and sizes indicated.
b. Gray-iron slotted grate.
c. Frame: Include gray-iron or steel frame for grate.

2.7 CATCH BASINS

A. Standard Precast Concrete Catch Basins:
1. Base Section: 15 cm (6-inch) minimum thickness for floor slab and 10 cm (4-inch) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
2. Riser Sections: 10 cm (4-inch) minimum thickness, 120 cm (48-inch) diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
4. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
6. Grade Rings: Include two or three reinforced-concrete rings, of 15-to 22.5 cm (6- to 9-inch) total thickness, that match 50 cm (24-inch-) diameter frame and grate.
7. Steps: Deformed, 12.5 mm (1/2-inch) steel reinforcing rods wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or

anchor steps into sidewalls at 30- to 40 cm (12- to 16-inch) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 1.5 meters.

8. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 60 by 60 cm (24 by 24 inches) minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 60 cm (24-inch) ID by 18 by 22.5. cm (7- to 9-inch riser) with 10 cm (4-inch) minimum width flange, and 66 cm (26-inch-) diameter flat grate with small square or short- slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.8 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, non-pressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.

2. Install piping 300 mm (12 inch) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 60 cm (24 inch) minimum cover.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure drainage piping according to the manufacturer's specifications.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade.
1. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 450 mm x 450 mm x 300 mm (18 by 18 by 12 inches) deep. Set with tops 25 mm (1 inch) above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 75 mm (3 inches) above finished surface elsewhere unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.9 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in 150 mm (6-inch) minimum concrete around bottom and sides.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

F. Embed channel sections in 150 mm (6-inch) minimum concrete around bottom and sides.

3.10 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 150 mm (6-inch) overlap, with not less than 150 mm (6 inches) of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 150 mm (6 inches) of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 75 mm (3 inches) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 150 mm (6 inches) of concrete for minimum length of 300 mm (12 inches) to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 60 cm (24 inches) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Replace leaking piping using new materials, and until leakage is within allowances specified.

END OF SECTION 334100

SECTION 334101 - ROCK SLOPE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Geotextile filter fabric.

2. Rock (Granular Material).

1.2 DESCRIPTION

A. Furnish all labor, materials, tools, and equipment necessary to complete all work involved in placing Rock Slope Protection (RSP), complete in place, as shown on the plans, as specified these specifications and as directed by the State's Representative.

1.3 PRODUCT DATA

A. For each geotextile filter fabric.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Geotextile Filter Fabrics:

1. Rock slope protection fabric shall conform to the requirements specified in Section 311271 of these specifications.

B. ROCK (Granular Material)

1. Rock used for Rock Slope Protection is not available within the project boundaries. It shall be the Contractor's responsibility to clean all rock secured from commercial or other sources outside the project boundaries. The individual classes of rocks used in rock slope protection shall conform to the following, unless otherwise specified, or as shown on the plans.

2. Granular material for rock slope protection (granular material) must be gravel, crushed gravel, rock, crushed rock, or any combination thereof.

3. Grading for granular material must comply with the requirements in this table:

GRADING OF ROCK SLOPE PROTECTION

Method B Placement Percentage Larger Than*								
Rock Mass	Classes							
	1T	1/2T	1/4T	Light	Facing	No. 1	No. 2	No. 3
2 Ton	0-5	—	—	—	—	—	—	—
1 Ton	50-100	0-5	—	—	—	—	—	—
1/2 Ton	—	50-100	0-5	—	—	—	—	—
1/4 Ton	95-100	—	50-100	0-5	—	—	—	—
200 Lb	—	95-100	—	50-100	0-5	0-5	—	—
75 Lb	—	—	95-100	—	50-100	50-100	0-5	—
25 Lb	—	—	—	95-100	90-100	90-100	25-75	0-5
5 Lb	—	—	—	—	—	—	90-100	25-75
1 Lb	—	—	—	—	—	—	—	90-100

4. The amount of material smaller than the smallest rock mass listed in the above tables for any class of rock slope protection shall not exceed the percentage limit listed in the above tables determined on a mass basis. Compliance with the percentage limit shown in the above tables for all other rock masses of the individual pieces of any class of rock slope protection shall be determined by the ratio of the number of individual pieces larger than the specified rock mass compared to the total number of individual pieces larger than the smallest rock mass listed in the above table for that class.

5. The material shall also conform to the following quality requirements:

Test	California Test	Requirement
Apparent Specific Gravity	206	2.5 min.
Absorption	206	4.2% max.*
Durability Index	229	52 min.*

6. Based on the formula listed below, absorption may exceed 4.2 percent if DAR is greater than 10. Durability Index may be less than 52 if DAR is greater than 24.

$$\frac{\text{CoarseDurabilityIndex}}{\%\text{Absorption} + 1} = \text{Durability Absorption Ratio (DAR)}$$

7. Rocks shall be angular, dense, durable and sound ranging in weight from 25 lbs to 500 lbs with at least 50% being in the 200 - 500 lbs size range.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Earthwork is specified in Section 312000 "Earth Moving."

3.2 ROCK LINING

A. Placement shall be according to methods approved by the Ministry of Public Works.

END OF SECTION 334101

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Geotextile filter fabrics.

1.2 ACTION SUBMITTALS

A. Product Data: For geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.

2.2 AGGREGATE MATERIALS

A. Clean Sand (44 mm)

B. Clean pea gravel (10 mm)

C. Clean crush, durable drain rock (20 mm to 40 mm)

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 FOUNDATION DRAINAGE INSTALLATION

A. Lay 60 mm sand bed

B. Lay 60 mm 10 mm pea gravel on top of sand

C. Place 20 mm of drain rock and lay 75 mm perforated drainpipe on top

D. Place 280 mm of drain rock (20 to 40 mm) over the pipe.

E. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed.

F. Place backfill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.3 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

3.4 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings with loose banded, coupled, or push-on joints.

B. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.5 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."

B. Cleanouts for Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

C. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

SECTION 334713 – POND AND WETLAND LINERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Geomembrane liners for wastewater treatment ponds and wetlands.

1.3 PERFORMANCE REQUIREMENTS

A. Provide geomembrane liners that prevent the passage of water. Geomembrane liner shall be puncture resistant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for geomembrane liners. Show panel layout, seams, penetrations, perimeter anchorage, and methods of attachment and sealing to other construction. Differentiate between factory and field seams and joints.

C. Samples: For each type of geomembrane panel, provide not less than one 30 cm seam length for factory-bonded sheets, and one 30 cm seam length for field-bonded sheets.

D. Proposed geomembrane panel layout in the proposed ponds. The drawings shall show: the direction of factory seams, the size of panels, and the location of field seams consistent with the requirements of the project drawings. These details shall include the recommended termination details of the geomembrane. Except for special requirements due to configuration and/or terminating the geomembrane, maximum use of large size panels shall be made to reduce field seaming to a minimum.

1.5 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products or an employer of workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.8 WARRANTY

A. Special Warranty: Specified form in which geomembrane manufacturer, geomembrane liner fabricator, and geomembrane liner Installer agree to repair or replace a geomembrane liner that fails in materials or workmanship or that deteriorates under conditions of normal weather within specified warranty period. Warranty does not include deterioration or failure of geomembrane liner due to exposure to harmful chemicals, gases or vapors, abnormal and severe weather phenomena, fire, earthquakes, floods, vandalism, or abuse by persons, animals, or equipment.

1. Failures include, but are not limited to, the following:
   a. Leaks in geomembrane liner.
   b. Defects in seams.

2. Warranty Period: 5 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PolyEthylene (PE) SHEET MATERIALS

A. PE Sheet: Formulated from virgin PE, compounded for use in hydraulic structures, and formed into uniform sheets.

1. Available Manufacturers:

   a. Agru America, Inc.
   b. Carlisle SynTec Incorporated.
   c. Colorado Lining International
   d. Cooley Group.
   e. GSE Lining Technology, Inc.; Div. of Gundle/SLT Environmental, Inc.
   f. Integra Plastics, Inc.
   g. Plastic Fusion Fabricators, Inc.
   h. Poly-Flex, Inc.
   i. Raven Industries, Inc.
   j. Reef Industries, Inc.
   k. Yunker Plastics, Inc.
   l. Approved Equivalent.

2. Sheet Texture: Both sides smooth.
3. Nominal Density: High Density, 0.940 to 0.959 g/cm^3
4. Nominal Thickness: 40 Mil thick sheet
5. Melt Flow Index: Not more than 1 gram per 10 minutes
6. Carbon Black Content: 2 to 3 percent
7. Oxidation Induction Time: Not less than 100 minutes
8. Tensile Properties: Not less than indicated for each direction

   a. Strength at Yield: Not less than 2250 kg/m and 14.5 MPa minimum average.
   b. Strength at Break: Not less than 4070 kg/m and 26 MPa minimum average.
   c. Elongation at Yield: Not less than 12 percent minimum average.
   d. Elongation at Break: Not less than 700 percent minimum average.

9. Tear Resistance: Not less than 170 N minimum average
10. Puncture Resistance: Not less than 480 N minimum average
11. Dimensional Stability, Reinforced Sheet: Not more than plus or minus 2 percent
12. Low-Temperature Brittleness: Four hours at minus 24 deg F
13. Environmental Stress Cracking Resistance: Not less than 1500 hours

2.2 MISCELLANEOUS MATERIALS

A. Adhesives: Provide types of adhesive primers, compounds, solvents, and tapes recommended in writing by geomembrane liner manufacturer

B. Penetration Assemblies: Provide manufacturer's standard factory-fabricated assemblies for sealing penetrations. Include joint sealant recommended in writing by geomembrane liner manufacturer and compatible with geomembrane liner, containment conditions, and materials.

C. Battens: Manufacturer's standard. Fabricate battens with sharp projections removed and edges eased and then predrilled or punched for anchors. Provide anchors, or other type of attachment, of type and spacing recommended in writing by geomembrane liner manufacturer for attaching geomembrane liner system to substrate and as indicated.

D. Sand: fine aggregate, natural or manufactured sand.

2.3 FABRICATION

A. Fabricate geomembrane liner panels from sheets in sizes as large as possible with factory-sealed seams, consistent with limitations of weight and installation procedures. Minimize field seaming.

2.4 SOURCE QUALITY CONTROL

A. Testing Agency: The Contractor will engage a qualified testing agency to evaluate geomembrane seams.

B. Destructive Testing: Test for bonded seam strength and peel adhesion every 1000 meters or once per panel, whichever is more frequent.

C. PE Liner: Test and inspect factory seams, for peel adhesion and for bonded seam strength indicated.

1. Peel Adhesion/Extrusion: Film tear bond and not less than 1390 kg/m of extrusion-bonded seam width.
2. Peel Adhesion/Fusion: Film tear bond and not less than 1600 kg/m of fused seam width.
3. Bonded Seam Strength: Not less than 2140 kg/m of seam width for seams constructed from two scrim-reinforced sheets, each with nominal sheet thickness of not less than 1 mm.

PART 3 - EXECUTION

3.1 STORAGE

A. PE Liner shall be properly stored to prevent damage per Manufacturer’s instructions.

3.2 INSTALLATION

A. Examine substrates, with Installer present, for compliance with requirements for soil compaction and grading; for subgrade free from angular rocks, rubble, roots, vegetation, debris, voids,

protrusions, and ground water; and for other conditions affecting performance of geomembrane liner.

B. Subgrade shall be maintained in a firm, clean, dry, and smooth condition during the lining installation.

C. Examine anchor trench excavation, where geomembrane liner will be secured, for substrate conditions indicated above and for correct location and configuration.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Provide temporary ballast, until edges are permanently secured, that does not damage geomembrane liner or substrate, to prevent uplift of geomembrane liner in areas with prevailing winds.

F. Prepare surfaces of construction penetrating through geomembrane liner according to geomembrane liner manufacturer's written instructions.

G. Remove curing compounds and coatings from concrete surfaces to be sealed to geomembrane liner.

H. Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and in compliance with geomembrane liner manufacturer's written instructions. Begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with minimum wrinkles, and in full contact with subgrade. Do not bridge over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.

I. Materials, equipment, or other items shall not be dragged across the surface of the RPE liner or be allowed to slide down slopes on the lining. All parties walking or working on the RPE lining material shall not wear shoes that have deep cleated soles that may damage the liner.

J. Field Seams: Comply with geomembrane liner manufacturer’s written instructions.

K. Install Pipe Boots at each pipe penetration.

L. Installation in Anchor Trench: Install geomembrane liner in trench according to manufacturer's written instructions. Backfill and compact to lock liner into trench.

M. Attachment to Concrete: Use manufacturer's standard system to suit Project conditions. Support adhesive and geomembrane on minimum 8-inch- wide concrete substrate unless otherwise indicated.

N. Protect installed geomembrane liner according to manufacturer's written instructions. Repair or replace areas of geomembrane liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.

O. Before initial filling of pond or placement of earth cover, inspect seams and patched areas to ensure tight, continuously bonded installation. Repair damaged geomembrane and seams per 3.3.K above and reinspect repaired work.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: The Contractor will engage a qualified testing agency to perform tests and inspections.

B. Nondestructive Testing: Visually inspect seams and patches. Complete Air Lance Test, Vacuum Box Testing, or Ultrasonic (High Frequency) Pulse Echo Testing, as applicable to geomembrane liner and seam construction. Record locations of failed seams and patches. Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches.

C. Prepare test and inspection reports.

END OF SECTION 334713

SECTION 460753 - POTABLE WATER TREATMENT EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:
   1. Coarse-media clarifier filters
   2. Multi-media filters.
   3. Chlorination tanks
   4. Polymer injection tanks

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For water filtration equipment. Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 COARSE MEDIA CLARIFIER FILTERS

A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Yardney Water Filtration Systems or Equivalent.

2. Basis-of-Design Product: Subject to compliance with requirements, provide Yardney sand media filter model IL-1824-2A or equivalent sand media filter.

3. Description: Duplex, skid-mounted, pre-assembled housing with pre-installed filter elements for removing suspended particles and pathogens from water.

   a. Housing: Corrosion resistant side-shell carbon steel filter vessel:

      1) Fusion bonded epoxy coating on interior surfaces of tanks and valves.
      2) Removable stainless steel wedgewire lateral underdrain assembly with Sch. 40 PVC hub.
      3) Easy-entry manways on top and side, and oversized media dump port on bottom of vessel.
      4) 3-way 454D pneumatically actuated valves
      5) Carbon steel manifolds with flanged mainline connections
      6) Backwash manifold with manal throttle valve to control backwash flow.
      7) Exterior pain catalyzed two-part polyurethane
      8) System is fully assembled, plumbed and wired on a structural steel skid.

   b. Filter Element(s):

      1) 0.056 cubic meters of 12-19 mm gravel
      2) 0.142 cubic meters of 0.47 mm silica sand media

4. Capacity and Characteristics:

   a. Filter Design:

      1) Continuous Flow: 8 m^3/hr
      2) Max Flow: 12 m^3/hr
      3) Filtration Efficiency: 98 percent retention of suspended particles 20 micrometers and larger from feedwater.
      4) Pressure Drop: Not to exceed 12 psi at filter design flow rate when dirty.
      5) Pressure rating: 40-100 psi

2.2 COARSE MEDIA CLARIFIER FILTERS

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Yardney Water Filtration Systems or Equivalent

2. Basis-of-Design Product: Subject to compliance with requirements, provide Yardney multimedia filter model MM 1860-2A or equivalent multimedia filter.

3. Description: Duplex, skid-mounted, pre-assembled housing with pre-installed filter elements for removing suspended particles and pathogens from water.

   a. Housing: Corrosion resistant side-shell carbon steel filter vessel:

      1) Fusion bonded epoxy coating on interior surfaces of tanks and valves.
      2) Removable stainless steel wedgewire lateral underdrain assembly with Sch. 40 PVC hub.
      3) Easy-entry manways on top and side, and oversized media dump port on bottom of vessel.
      4) 3-way 454D pneumatically actuated valves
      5) Carbon steel manifolds with flanged mainline connections
      6) Backwash manifold with manal throttle valve to control backwash flow.
      7) Exterior pain catalyzed two-part polyurethane
      8) System is fully assembled, plumbed and wired on a structural steel skid.

   b. Filter Element(s):

      1) 0.028 cubic meters of 12-19 mm gravel
      2) 0.028 cubic meters of 1.45 mm garnet media
      3) 0.071 cubic meters of 0.35 mm garnet media
      4) 0.071 cubic meters of 0.75 mm anthracite media

4. Capacity and Characteristics:

   a. Filter Design:

      1) Continuous Flow: 8 m^3/hr
      2) Max Flow: 12 m^3/hr
      3) Filtration Efficiency: 98 percent retention of suspended particles 20 micrometers and larger from feedwater.
      4) Pressure Drop: Not to exceed 12 psi at filter design flow rate when dirty.
      5) Pressure rating: 40-100 psi

2.3 CHLORINE STORAGE TANK AND METERING PUMP

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Stenner Pumps

2. Basis-of-Design Product: Subject to compliance with requirements, provide 115 L Stenner storage tank with a factory-installed classic single head adjustable metering pump, or equivalent tank and pump package.

3. Description: 115 L Stenner storage tank with a factory-installed classic single head adjustable metering pump, or equivalent tank and pump package for injecting chlorine at a fixed rate into domestic water supply for water treatment.

   a. Tank

1) Tank Material: polyethylene
2) Lid with child resistant lock: polypropylene
3) Grommets: viton
4) Screws: stainless steel

b. Pump
1) Stenner classic single head fixed peristaltic pump Model 45MJH1, or equivalent

4. Capacity and Characteristics:
a. Pump
1) Design output flow at 50Hz: 9 L/day with a chlorine solution of 12.5% chlorine diluted at 4:1 for a concentration of 2 mg/L in the domestic water supply.
2) Maximum pressure: 100 psi
3) 3-point roller design to assist in anti-siphon protections
4) No valves, allows for easy maintenance.
5) Self-priming against maximum working pressure
6) Injection check valve is factory-installed and rated up to 100 psi.
7) Motor type: 1/30 HP, shaded pole, class B
8) Motor voltage: 230 V 50Hz 1PH

5. Mounting: Tank will be mounted on a concrete base constructed to local standards.

2.4 ALUM STORAGE TANK AND METERING PUMP

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Stenner Pumps or Equivalent

2. Basis-of-Design Product: Subject to compliance with requirements, provide 115 L Stenner storage tank with a factory-installed classic single head adjustable metering pump, or equivalent tank and pump package.

3. Description: 115 L Stenner storage tank with a factory-installed classic single head adjustable metering pump, or equivalent tank and pump package for injecting chlorine at a fixed rate into domestic water supply for water treatment.

a. Tank

1) Tank Material: polyethylene
2) Lid with child resistant lock: polypropylene
3) Grommets: viton
4) Screws: stainless steel

b. Pump
1) Stenner classic single head adjustable peristaltic pump Model 85MJH7, or equivalent

4. Capacity and Characteristics:
   a. Pump
      1) Design output flow at 50Hz: 120 L/day with a source alum solution of 33 g/L for a final concentration of ~20 mg/L in the water supply.
      2) Maximum pressure: 100 psi
      3) 3-point roller design to assist in anti-siphon protections
      4) No valves, allows for easy maintenance.
      5) Self-priming against maximum working pressure
      6) Injection check valve is factory-installed and rated up to 100 psi.
      7) Motor type: 1/30 HP, shaded pole, class B
      8) Motor voltage: 230 V 50Hz 1PH

5. Mounting: Tank will be mounted on a concrete base constructed to local standards.

2.5 SOURCE QUALITY CONTROL

A. Before shipping, hydrostatically test carbon filters to minimum of one and one-half times pressure rating.

B. Prepare test reports.

PART 3 - EXECUTION

3.1 EQUIPMENT MOUNTING

A. Equipment Mounting: Filters are factory installed on a stainless steel skid.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 331116 "Site Water Utility Distribution." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between water filtration equipment and dissimilar-metal water piping with dielectric fittings. Comply with requirements for dielectric fittings specified in Section 331116 "Site Water Utility Distribution."

D. Install shutoff valves on feedwater-inlet and filtrate-outlet piping of each water filtration equipment filter.

   1. Comply with requirements for metal general-duty valves specified in Section 331116 "Site Water Utility Distribution."
   2. Comply with requirements for plastic valves specified in Section 331116 "Site Water Utility Distribution."
   3. Exception: Water filtration equipment with factory-installed shutoff valves at locations indicated.

E. Filters are factory-installed with pressure gages at the locations indicated on the plans.

F. Install valved bypass water piping around each water filtration equipment filter.

1. Comply with requirements for water piping specified in Section 221116 "Domestic Water Piping."

G. Install drains to direct waste over floor drains.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 331116 "Site Water Utility Distribution."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Domestic water filtration equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 460713

460753 - WASTEWATER TREATMENT AND DISPOSAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Work Included: The Work of this Section includes, but is not limited to the following:

1. Anaerobic baffled reactor tank.
2. Trickling filters.
3. Distribution boxes.
4. Pipe and fittings.
5. Mulch Basins.

1.3 ACTION SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show equipment sizes, locations, and elevations. Show control panel layout.

B. Product Data: Include material descriptions, rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

C. Shop Drawings:

1. Include manhole openings, covers, pipe connections, and accessories.
2. Include piping with sizes and invert elevations.
3. Include underground structures.
4. Include other utilities.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CONCRETE OR CONCRETE MASONARY UNIT (CMU) ANAEROBIC BAFFLED REACTOR

A. Design: For traffic loading according to local standards.

B. Manholes: 600mm x 600mm minimum square opening or 600mm minimum diameter opening with reinforced-concrete risers to grade and access lid with steel lift rings. Position manholes to allow access to each compartment.

C. Inlet and Outlet Access: Include access centered over inlet, outlet, and to allow access to each ABR chamber.

D. Resilient Connectors: Size required for piping, fitted into inlet and outlet openings, and baffle openings.

E. Capacity and Characteristics:

1. Capacity: As shown in design plans.
2. Inlet and Outlet Size: As shown in the design plans.
3. Baffles: As shown in design plans.

2.2 ABOVE GROUND TRICKLING FILTERS

A. Above ground trickling filters shall consist of above ground tanks, trickling filter media, media support decking, spray nozzles, vents, duplex pump systems, and drain valves.

1. Trickling filter tanks shall be constructed of concrete or an approved equivalent material, and shall be the size, capacity, and dimensions presented on the design plans.

a. Concrete shall meet local standards and requirements.
b. Reinforcing bars: Grade 60, zinc-coated billet steel bars or approved local equivalent.

2. Trickling filter spray nozzles shall be designed for spraying wastewater without clogging and meeting the following requirements:

a. Manufacturer: Spraying Systems Co. or approved equivalent.
b. Material: 316 stainless steel or brass.
c. Spray nozzle size and capabilities: as indicated on the design drawings.

3. Trickling filter plastic media shall be a plastic random media intended for trickling filter applications meeting the following requirements:

a. Manufacturers: Raschig or approved equivalent.
b. Material: UV-stabilized polypropylene
c. Specific surface area: 100 square meters per cubic meters.
d. Void Ratio: 95 percent.

4. Trickling filter media deck shall be manufactured by the same manufacturer of the trickling filter media intended for trickling filter applications and meeting the following requirements:

a. Allowing for passage of air, wastewater, biomass, and solids.
b. Height: 14 cm.

5. Vents shall not open upwards. Each tank shall have three vents each consisting of a 50 mm tee with screen cover and coupling. Vents shall include an 8 mesh 0.25 mm (0.01 inch) wire gage stainless screen, constructed to prevent entrances of rain, insects, birds, and animals.

6. Trickling filter pump systems shall meet the requirements shown on the plans and in Section 333216 “Utility Sanitary Sewerage Pump Systems.”

B. RECIRCULATING BALL VALVES

1. The recirculating ball valve shall be as indicated on the plans to provide guaranteed return of treated effluent. The recirculating ball valve is designed to redirect a fraction of the flow to the ABR during period of low flow or to the final pump tank during periods of high flow. The valve shall be manufactured of corrosion resistant PVC, fiberglass, polyethylene and ABS components and allow for easy removal using a sliding quick disconnect.

C. PE and PVC DISPOSAL DISTRIBUTION PIPE AND FITTINGS

D. Tube and Fittings: Perforated corrugated tube with solid-wall fittings, matching size shown on plans.

E. Couplings: PE band, matching tube and fitting dimensions.

2.3 NONPRESSURE PIPE COUPLINGS

A. Description: Comply with local standards, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Sleeve Materials for Plastic Pipes: Approved Elastomeric seal or PVC.
2. Sleeve Materials for Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

2.4 MULCH BASIN MATERIALS

A. Mulch: 25mm to 50mm, free of sticks, dirt, dust or other debris.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling

1. Stockpile topsoil for reuse in finish grading without intermixing with other excavated material. Stockpile materials away from edge of excavation and do not store within drip line of remaining trees.
2. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

B. Excavating and Backfilling for Anaerobic Baffled Reactor Tank:

1. Excavate sufficient width and length for tanks to depth determined by tank inlet elevation. Provide level bottom.
2. Backfill with excavated soil, mounding soil above original grade without compacting.

C. Excavating and Backfilling for Mulch Basins:

1. Excavate to minimum dimensions presented in the design plans.
2. Backfill with mulch, mounding mulch 5cm or specified height above original grade without compacting.
3. Spread and compact excavated soil of a large approved area at a maximum thickness of 150 mm.

3.2 ANAEROBIC BAFFLED REACTOR INSTALLATION

A. Install anaerobic baffled reactor according to local standards.

B. Install anaerobic baffled reactor level.

C. Connect anaerobic baffled reactor to concrete ballast pad.

D. Waterproof all sections of each anaerobic baffled reactor.

E. Fill anaerobic baffled reactor with water and test for water tightness (see field quality control section below).

3.3 TRICKLING FILTER INSTALLATION

A. Install trickling filter tank according to local standards.

B. Install trickling filters level.

C. Waterproof trickling filter tank to be watertight.

D. Fill trickling filter tank with water and test for water tightness (see field quality control section below).

E. Install trickling filter spray nozzles according to manufacturer's instructions. Install spray nozzles at spacing and orientation shown on plan in order to obtain full spray coverage over the trickling filter media.

F. Install trickling filter media and underdrain according to manufacturer's instructions and recommendations.

3.4 PIPING INSTALLATION

A. Install mulch basin piping according to the design plans. Comply with requirements for sewer pipe installation specified in Section 333100 "Utility Sanitary Sewers."

3.5 PIPE JOINT CONSTRUCTION

A. Join mulch basin piping with or according to the following:

1. Install pipe and fittings for mulch basin with closed joints unless otherwise indicated.

B. Join dissimilar pipe materials according to local standards, with couplings and gaskets compatible with pipe materials being joined.

3.6 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 333100 "Utility Sanitary Sewers."

3.7 IDENTIFICATION

A. Arrange for installation of detectable warning tape directly over piping, at outside edges of underground structures, and along length of mulch basin laterals.

3.8 FIELD QUALITY CONTROL

A. System Tests: Perform testing of completed trickling filter system and anaerobic baffled reactor system piping and structures according to authorities having jurisdiction.

B. Additional Tests: Fill tanks with water and let stand overnight. If water level recedes, locate and repair leaks and retest. Repeat tests and repairs until no leaks exist.

3.9 CLEANING

A. Clear interior of piping and structures of dirt and other superfluous material as work progresses.

B. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of workday or when work stops.

END OF SECTION 460753