

REPLACE BOILERS NO. 1 & 2 GUAM MEMORIAL HOSPITAL

850 GOV. CARLOS G. CAMACHO ROAD
TAMUNING, GUAM 96913



10/23/2024
100% SUBMITTAL

SPECIFICATIONS

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**REPLACE BOILERS NO. 1 & 2
GUAM MEMORIAL HOSPITAL
Tamuning, Guam**

Specifications

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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Contractor use of site and premises.
- B. Work Sequence.
- C. Owner Occupancy.
- D. Summary of the Work.

1.02 CONTRACTOR USE OF SITE AND PREMISES

- A. Limit of site and premises to allow:
 - 1. Owner occupancy of existing hospital building.
 - 2. Use of existing hospital building and premises by public.

1.03 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Contracting Officer and Owner's representative.
- B. Construction Phasing: Work involving alterations and/or additions to existing occupied areas shall be programmed and phased to minimize disruption of existing functions. Access, exits, and fire protection shall be so maintained that the occupant's safety health, and reasonable comfort will not be jeopardized during construction.

1.04 OWNER OCCUPANCY

- A. The Owner will occupy the existing hospital building during entire period of construction.
- B. Cooperate with Owner to minimize conflict and noise, and to facilitate Owner's operations. Contractor shall work with the hospital staff to minimize interference of hospital operations.
- C. Schedule all Work to accommodate this requirement.

1.05 SUMMARY OF WORK

The Replace Chillers and Pumps scope work includes the following:

- A. Mechanical
 - 1. Removal of existing and providing new packaged Boilers no.1 and 2 and associated components, Packaged day tank, fuel lines and vent stack.
 - 2. Provide new economizers.
- B. Electrical
 - 1. Removal of existing and providing new power supply to new equipment and controls.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01020
PHASING OF CONSTRUCTION

PART 1 - GENERAL

1.01 HOSPITAL OPERATIONS

- A. Contractor will work with the hospital staff to minimize interference of hospital operations.

1.02 MATERIALS AND SUPPLIES

- A. The Contractor shall not begin a phase area before all supplies for that work are on-island.

1.03 GENERAL REQUIREMENTS

- A. Replacement of Boilers no. 1 and 2 shall be phased. One Boiler must be operational before starting removal work.
- B. Before submitting a bid, contractor shall familiarize themselves with Hospital regulations that could impact their construction time.

END OF SECTION

SECTION 01039
COORDINATION AND MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Coordination.
- B. Field engineering.
- C. Preconstruction conference.
- D. Site mobilization conference.
- E. Progress meetings.

1.02 RELATED SECTIONS

- A. Section 01010 Summary of Work - Work Sequence, Owner Occupancy
- B. Section 01045 Cutting and Patching.
- C. Section 01049 Mechanical and Electrical Coordinator.

1.03 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various Sections of Specifications to assure an efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

1.04 PRECONSTRUCTION CONFERENCE

- A. Attendance Required: Owner, Contracting Officer, Engineer and Contractor.
- B. Agenda:
 - 1. Submission of executed bonds and insurance certificates.
 - 2. Distribution of Contract Documents.
 - 3. Submission of list Subcontractors, list of products, Schedules of Values, Construction Phasing Schedule, and Progress schedule.
 - 4. Designation of personnel representing the parties in Contract, and the Contracting Officer.
 - 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders and Contract closeout procedures.
 - 6. Scheduling and Phasing of the Work.

1.05 SITE MOBILIZATION CONFERENCE

- A. Contracting Officer will schedule a conference at the project site prior to Contractor occupancy.
- B. Attendance Required: Owner, Contracting Officer, Special Consultants, and Contractor and major Subcontractors.
- C. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements and partial occupancy.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and layout.
 - 6. Security and housekeeping procedures.
 - 7. Environmental protection, construction facilities and temporary controls.
 - 8. Schedules.
 - 9. Procedures for testing.
 - 10. Procedures for maintaining record documents.
 - 11. Requirements for start-up of equipment.
 - 12. Inspection and acceptance of equipment put into service during construction period.

1.06 PROGRESS MEETINGS

- A. The Contracting Officer will schedule and administer meetings throughout progress of the Work at weekly intervals.
- B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Contracting Officer, as appropriate to agenda topics for each meeting.
- C. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems which impede planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of off-site fabrication and delivery schedules.

7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01045
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

- A. Section 01010 - Summary of Work
- B. Section 01300 - Submittals
- C. Section 01500 - Temporary Controls
- D. Section 01560 - Environmental Protection

1.03 SUBMITTALS

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Efficiency, maintenance, or safety of any operational element.
 - 3. Environment, safety, or operation of any occupied area.
 - 4. Acoustic integrity of any area of the Project.
- B. Include in request:
 - 1. Location and description of affected work.
 - 2. Date and time work will be executed.
 - 3. Proposed protection measures to assure efficiency, maintenance, and safety of operational elements, and acceptable environmental, safety and operations considerations for occupied areas.

PART 2 - PRODUCTS

- A. Fire stopping sealant shall be one-part fire stop sealant and one of the following:
 - 1. Dow Corning Fire Stop Sealant
 - 2. 3M Fire Barrier Caulk CP-25
 - 3. Fyre Putty, Product of Standard Oil Engineer Materials

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing work, inspect conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work.

3.03 CUTTING AND PATCHING

- A. Execute cutting, fitting, and patching including excavation and fill complete work.

3.04 PERFORMANCE

- A. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing.
- B. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- C. Restore work with new products in accordance with requirements of Contract Documents.
- D. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break.
- F. Work shall meet acoustic performance requirements of each area of the project.

3.05 FIRE SAFING

- A. All penetrations through rated walls, partitions and floors shall be fire-safed using one part fire stop sealant.

END OF SECTION

SECTION 01049
MECHANICAL AND ELECTRICAL COORDINATOR

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Mechanical and Electrical Coordinator.
- B. Submittals.
- C. Coordination required.
- D. Coordination documents.
- E. Coordination of submittals.
- F. Coordination of substitutions and modifications.
- G. Observation of Work.
- H. Documentation.
- I. Equipment start-up.
- J. Inspection and acceptance of equipment.

1.02 RELATED SECTIONS

- A. Section 01010 - Summary of Work.
- B. Section 01039 - Coordination and Meetings: Coordination.
- C. Section 01045 - Cutting and Patching: Cutting and Patching.
- D. Section 01039 - Coordination and Meetings: Progress Meetings.
- E. Section 01300 - Submittals.
- F. Section 01300 - Submittals: Shop drawings, product data, and samples.
- G. Section 01700 - Contract Closeout Procedures

1.03 MECHANICAL AND ELECTRICAL WORK COORDINATOR

- A. Employ and pay services of a person technically qualified and experienced in field coordination for the type of mechanical and electrical work required for this Project, for the duration of the Work.
- B. The electrical and mechanical coordinator should be a separate person from the project manager, project engineer or supervisor. The coordinator should be able to provide training and in service assistance to end user.

1.04 SUBMITTALS

- A. Submit name, address, and telephone number of Coordinator to Contracting Officer for approval.
- B. Submit coordination drawings and schedules prior to submitting shop drawings, product data, and samples.

1.05 COORDINATION REQUIRED

- A. Coordinate work of Division 2, 9, 15 and 16, with work of other Divisions.
- B. Coordinate the work with progress schedules established under Section 01300, including dates for submittals and for delivery of products.
- C. Conduct conferences among Subcontractors and separate contractors and other concerned with the Work, to establish and maintain coordination and schedules.
- D. Participate in progress meetings. Report on progress of Work to be adjusted under coordination requirements, and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.

1.06 COORDINATION DOCUMENTS

- A. Prepare coordination drawings to organize installation Products for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.
- B. Prepare a master schedule to identify responsibilities under each section of Division 1 through 16 of the Specifications for activities which directly relate to this work, including submittals and temporary utilities. Identify electrical power characteristics and control wiring required for each item of equipment.
- C. Maintain documents for the duration of the Work, recording changed due to site instructions, modifications or adjustments.
- D. After Contracting Officer review of original and revised documents, reproduce and distribute copies to concerned parties.

1.07 COORDINATION OF SUBMITTALS

- A. Review shop drawings, product data, and samples for compliance with Contract Documents and for coordination among work of all sections of the Project Manual. Transmit to Contractor for review, then transmit to Contracting Officer.
- B. Check field dimensions and clearances and relationship to available space and anchors.
- C. Check compatibility with equipment and Work of other sections, electrical characteristics, and operational control requirements.
- D. Check motor voltage and control characteristics.
- E. Coordinate controls, interlocks, wiring of pneumatic switches, and relays.
- F. Coordinate wiring and control diagrams.
- G. Review the effect of any changes on work of other sections.

- H. Verify and coordinate maintenance of Record Documents.
- 1.08 COORDINATION OF SUBSTITUTIONS AND MODIFICATIONS
- A. Review proposals and requests from subcontractors.
 - B. Verify compliance with Contract Documents and for compatibility with Work and Products of other sections.
 - C. Submit three (3) copies of documentation to Contracting Officer or Authorize Representative.
- 1.09 OBSERVATION OF WORK
- A. Observe Work for compliance with Contract Documents.
 - B. Maintain a list of observed deficiencies and defects; promptly submit to Contractor.
- 1.10 DOCUMENTATION
- A. Observe and maintain a record of tests. Record:
 - 1. Specification section number, Product, and name of Subcontractor.
 - 2. Name of testing agency and name of inspector.
 - 3. Name of manufacturer's representative present.
 - 4. Date, time, and duration of tests.
 - 5. Type of tests, and results.
 - 6. Retesting required.
 - B. Assemble background documentation for dispute and claim settlement by Contracting Officer.
 - C. Submit three (3) copies of documentation to Contracting Officer or Authorize Representative.
- 1.11 EQUIPMENT START-UP
- A. Verify utilities, connections and controls are complete and equipment is in operable condition as required by Section 01650.
 - B. Observe startup and adjustments: record item and date of start-up, and results.
 - C. Observe equipment demonstrations to Owner: record times and additional information required for Operation and Maintenance Manuals.
- 1.12 INSPECTION AND ACCEPTANCE OF EQUIPMENT
- A. Prior to inspection, verify that equipment is tested and operational, and clean.
 - B. Assist Contracting Officer with inspection. Prepare list of items to be completed and corrected.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Shop drawings.
- E. Product data.
- F. Manufacturer's instructions.
- G. Manufacturer's certificates.
- H. Construction photographs.
- I. As-Built Drawings.
- J. Equipment Manuals.

1.02 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's field services and reports.
- B. Section 01700 - Contract Closeout: Contract warranty and manufacturer's certificates.

1.03 SUBMITTAL PROCEDURES

- A. Transmit each submittal with form acceptable to Contracting Officer.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite the Project and deliver to Contracting Officer.
- F. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed work.
- G. Provide space for Contractor and Contracting Officer review stamps.
- H. Revise and resubmit submittals as required, identify all changes made since previous submittal.

- I. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- J. Contractor shall provide an approved submittal log indicating the type submittal, scheduled submittal date and status of submittal approval.

1.04 CONSTRUCTION PROGRESS SCHEDULES

- A. The Contractor shall prepare a computerized project schedule approved by Guam Memorial Hospital Authority and the Architect and shall be used to monitor the contractor's performance. The Contractor shall update and review the computerized the project schedule with Guam Memorial Hospital Authority and the Architect on a monthly basis or sooner if necessary.

1.05 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.06 SHOP DRAWINGS

- A. Submit six (6) copies.
- B. After review, and distribute in accordance with Article on Procedures above and for Record Documents described in Section 01700 - Contract Closeout.

1.07 PRODUCT DATA

- A. Submit a minimum of 4 copies, 3 are to be retained by Contracting Officer.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturer's standard data to provide information unique to this Project.
- C. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in Section 01700 - Contract Closeout.
- D. Product data should include MSDS (Material Safety Data Sheets).

1.08 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification Sections, submit manufacturer's printed instruction for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.09 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification Section, submit manufacturer's certificate to Contracting Officer's for review, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit

supporting reference date, affidavits, and certifications as appropriate.

- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Contracting Officer.

1.10 AS-BUILT DRAWINGS

- A. Upon completion of the contract, the contractor shall provide to the Owner a complete set of legible reproducible drawings showing all construction, fixed equipment, architectural, civil, structural, mechanical, and electrical in clean, undamaged condition, with markup of actual installations as installed or built.
- B. The Contractor shall also provide three (3) sets of as-built condition drawings in Autocad R14/2000 format and Autocad electronic copy in CD upon completion and acceptance of the project.

1.11 EQUIPMENT MANUALS

- A. The Contractor shall furnish to the Owner three (3) binder sets of Equipment Installation, Operation and Maintenance Manuals.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. References.
- C. Inspection and testing laboratory services.
- D. Manufacturers' field services and reports.

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals: Submission of Manufacturers' Instructions and Certificates.

1.03 QUALITY ASSURANCE/CONTROL INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply fully with manufacturer's instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from the Contracting Officer before proceeding.
- D. Comply with specified standards as a minimum quality for each the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship or specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.04 INSPECTION AND TESTING LABORATORY SERVICES

- A. Provide testing by an independent testing laboratory as specified in the General Conditions.
- B. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Contracting Officer.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities, Electricity, lighting, telephone service, water, and sanitary facilities.
- B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work.
- C. Construction Facilities: Progress cleaning, project signage, and temporary buildings.
- D. Erosion Control Facilities.

1.02 RELATED SECTIONS

- A. Section 01020 - Phasing of Construction.
- B. Section 01700 - Contract Closeout: Final cleaning.

1.03 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site and structure from damage.

1.04 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and plastic, dust tight sheet materials with closed joints and sealed edges at intersections with existing surfaces.
- C. GMH is a smoke-free facility. There shall be no smoking inside the hospital. This applies regardless of the closure of an area for construction.
- D. Contractor shall secure all work areas.
- E. Contractor shall be responsible for maintaining all his on-site equipment secure against vandalism. All contractor supplies must be secured each day. The Contractor is responsible for the replacement of all items lost due to theft.

1.05 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification sections

1.06 PARKING

- A. The Contractor is to adhere to the Hospital's policy in designated parking during construction.

1.07 DUST CONTROL AND PROGRESS CLEANING

- A. Maintain all areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove waste materials, debris, and rubbish from work areas daily and from site weekly and dispose off-site.

1.08 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Clean and repair damage caused by installation or use of temporary work.
- B. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.09 UTILITY OUTAGES

- A. Contractor shall be advised that GMHA has specific procedures and programs to be placed in effect for utility outages.
- B. Contractor shall familiarized himself with outage procedures and adhere to all requirements.
- C. Any and all utility outages must be coordinated with GMHA two (2) weeks in advance.

1.10 WELDING WORK

- A. GMHA requires the processing of a welding permit for all work within the Hospital facility.
- B. Necessary documentation must be completed by Contractor prior to welding work.

1.11 UTILITIES

- A. Source of water and electricity to be provided by Owner. Contractor to coordinate with Owner point of connections. Telephone is not required.

1.12 FIELD OFFICES AND SHEDS

- A. No field office required.

1.13 ENCLOSURES

- A. Furnish, install, and maintain for the duration of construction all scaffolds, tarpaulins, barricades, canopies, warning signs, steps, bridges, platforms, and other temporary construction necessary for proper completion of the work and protection of the public in compliance with pertinent safety and other regulations.

1.14 PROJECT SIGN

- A. Provide 2 each 4' x 8' temporary construction sign of design to be provided by Engineer. Locate signs as indicated or as directed. Use new materials, 3/4" exterior plywood with hardwood edge trim; mount on nominal 4 x 4 posts.

Use primer and two coats of exterior paint on sign background and posts. Use exterior paint on lettering. Have lettering performed by a professional sign painter.

Allow no other signs (except safety, directional or warning signs) or advertising of any kind on the job site.

1.15 OWNERSHIP OF TEMPORARY FACILITIES AND CONTROLS

- A. Items provided by the Contractor under this section shall remain the property of the Contractor and shall be removed from the job site immediately upon completion of the work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 ACCESS PROVISION

- A. Provide ramps, stairs, ladders and similar temporary access elements as reasonably required to perform the work and to facilitate its inspection during installation. Comply with reasonable requests of governing authorities performing inspections. When permanent stairs are available for access during construction, cover finished surfaces with sufficient protection to ensure freedom from damage and deterioration at time of substantial completion.

3.02 SECURITY/PROTECTION PROVISION

- A. The types of temporary security and protection provisions required include, but not by way of limitation, fire, protection, barricades, warning signs/lights, site enclosure fence, building enclosure/lockup, watchman service, personnel security program (theft prevention), environmental protection, and similar provisions intended to minimize property losses, personal injuries and claims for damages at project site.
- B. The Contractor shall erect, install and maintain all temporary public roads and walkways, warning signs, barricades or other protective means in and around the site as deemed necessary or as may be ordered by the Architect/Engineer for effective protection of the public from injury and shall be held strictly liable for their safety.

END OF SECTION

SECTION 01560
ENVIRONMENTAL PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Dust Control.
- B. Noise Control.

1.02 RELATED SECTIONS

- A. Section 01010 - Summary of Work
- B. Section 01039 - Coordination and Meetings
- C. Section 01500 - Construction Facilities and Temporary Controls: Construction Cleaning

1.03 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere, and into the air conditioning system.

1.04 NOISE CONTROL

- A. Minimize noise transmitted by vibration into occupied portion of structures during demolition work. Accomplish this by first separating the portion to be demolished from the portion to remain.
- B. Execute the separation from existing structure by cutting as specified in Section 01045 - Cutting and Patching.
- C. Contractor shall comply with GMHA noise control policies.

1.05 ASBESTOS REMOVAL

- A. In the event that asbestos is encountered in any existing elements of the building, the Contractor shall immediately stop work, notify the Owner and take all necessary precautions to protect persons in the vicinity from contamination.
- B. The Contractor, the Owner and the Contracting Officer shall all cooperate to have the asbestos removed by licensed, qualified contractor as expeditiously as possible, at the Owner's expense.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01650
STARTING OF SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Starting systems.
- B. Demonstration and instructions.
- C. Testing, adjusting, and balancing.

1.02 RELATED SECTIONS:

- A. Section 15000 - General Mechanical Requirements.

1.03 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Contracting Officer seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of equipment and system under normal and emergency mode to Owner's personnel two (2) weeks prior to date of final inspection.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item or equipment.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.05 TESTING, ADJUSTING, AND BALANCING

- A. Provide the services of independent firm to perform services specified in Section 15500 paragraph 3.06 and 3.07

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Closeout procedures.
- B. Final Cleaning.
- C. Adjusting.
- D. Project record documents.
- E. Operation and maintenance data.
- F. Warranties.
- G. Spare parts and maintenance materials.

1.02 RELATED SECTIONS

- A. Section 01500 - Construction Facilities and Temporary Controls: Progress cleaning.

1.03 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Contracting Officer's inspection.
- B. Provide submittals to the Contracting Officer that are required by governing or other authorities. Record and submit occupancy permit. Submit lien releases as required by law.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy portions of the building as specified in Section 01010 - Summary of Work.

1.04 FINAL CLEANING

- A. Execute final cleaning prior to final inspection.
- B. Clean debris from roofs, gutters, downspout, and drainage system.
- C. Clean site, sweep paved areas, rake clean landscaped surfaces.
- D. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.05 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.06 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change orders and other Modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. As-Built Drawings - Reproducible set.
- B. Store Record Documents separate from documents used for construction.
- C. Specification: Legibly mark and record at each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and Modifications.
- D. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract Drawings.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit three sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, capacity expansion binders with durable plastic covers.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Part 1: Directory, listings names, addresses, and telephone numbers of Contracting Officer, Contractor, Subcontractors, and major equipment suppliers.
- E. Part 2: Operation and maintenance instruction. Identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - 1. List of equipment.
 - 2. Parts list for each component.

3. Operating instructions.
 4. Maintenance instructions for equipment and systems.
 5. Repair and maintenance instructions for special finishes including recommended cleaning methods and materials and special precautions identifying detrimental agents.
 6. Complete electrical control diagram and schematics.
- F. Part 3: Project documents and certificates, including the following:
1. Shop drawings and product data.
 2. Certificates.
 3. Photocopies of warranties.
 4. As-built drawings including electrical control diagrams – reproducible set.
- G. Submit one copy of completed volumes in final form, to the Government, 15 days prior to final inspection. This copy will be returned after final inspection, with comments. Revise contents of documents as required prior to final submittal.
- H. Submit final volumes revised, within ten days after final inspection.

1.09 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities as recommended by equipment manufacturer covering 1 year of recommended spare parts.

1.10 WARRANTIES

- A. Contractor shall provide complete warrantee documentation for all items installed with a warranty provision. Documentation shall clearly state the start and end dates of each warrantee.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 03200
CONCRETE REINFORCING

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. Steel reinforcement bars.
 2. Welded-wire reinforcement.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Guam Memorial Hospital, Barrigada Guam.
1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Each type of steel reinforcement.
 2. Epoxy repair coating.
 3. Zinc repair material.
 4. Bar supports.
- B. Shop Drawings: Comply with ACI SP-066:
1. Include placing drawings that detail fabrication, bending, and placement.
 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For delegated-design engineer, testing and inspection agency.
- B. Delegated-Design Engineer Qualifications: Include the following:
 - 1. Experience providing delegated-design engineering services of the type indicated.
 - 2. Documentation that delegated-design engineer is licensed in the state in which Project is located.
- C. Welding certificates.
 - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
- D. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- C. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.
 - 1. Build panel approximately 100 sq. ft. for formed surface in the location indicated on Drawings or, if not indicated, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Galvanized.
- C. Zinc Repair Material: ASTM A780/A780M.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than **1 inch**, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with **ACI 318**.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or **24 inches**, whichever is greater.
 2. Stagger splices in accordance with **ACI 318**.
 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed **12 inches**.
 2. Lap edges and ends of adjoining sheets at least one wire spacing plus **2 inches** for plain wire and **8 inches** for deformed wire.
 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 4. Lace overlaps with wire.
- H. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in accordance with ASTM A780/A780M.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with **ACI 117**.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel-reinforcement placement.
 - 2. Steel-reinforcement mechanical splice couplers.
 - 3. Steel-reinforcement welding.

END OF SECTION 032000

SECTION 03300
CAST-IN-PLACE CONCRETE

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. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Guam Memorial Hospital, Barrigada Guam.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.

- f. Hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Aggregates.
- 3. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, and temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 4. Vapor retarders.
- 5. Floor and slab treatments.
- 6. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 7. Joint fillers.
- 8. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Slump limit.
- 6. Air content.
- 7. Nominal maximum aggregate size.
- 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 9. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
- 10. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
- 11. Intended placement method.
- 12. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.
 4. Formed Surface Finish designation and final finish.
 5. Final finish for floors.
 6. Curing process.
 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Curing compounds.
 4. Floor and slab treatments.
 5. Bonding agents.
 6. Adhesives.
 7. Vapor retarders.
 8. Semirigid joint filler.
 9. Joint-filler strips.
 10. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 1. Portland cement.
 2. Aggregates.
 3. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- C. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

A. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance

with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.

2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 9. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Sheet Vapor Retarder, Class C: ASTM E1745, Class C; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
- C. Sheet Vapor Retarder/Termite Barrier: ASTM E1745, Class A, except with maximum water-vapor permeance of 0.03 perms; complying with ICC AC380. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 1. Low-Temperature Flexibility: Pass at minus 15 deg F; ASTM D146/D146M.
 2. Puncture Resistance: 224 lbf minimum; ASTM E154/E154M.
 3. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D570.
 4. Hydrostatic-Head Resistance: 231 feet minimum; ASTM D5385.

2.4 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing **No. 4** sieve.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
- C. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

2.5 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd.** when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below **50 deg F**: Black.
 - b. Ambient Temperature between **50 deg F** and **85 deg F**: Any color.
 - c. Ambient Temperature Above **85 deg F**: White.
- D. Curing Paper: **Eight-feet-** wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

- J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Floor Slab Protective Covering: **Eight-feet-** wide cellulose fabric.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/8 inch** and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than **4100 psi** at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/4 inch** and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than **5000 psi** at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with **ACI 301**.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
 3. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
1. Use water-reducing high-range water-reducing or plasticizing 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.
 3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 5. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: **ACI 318** F0 S0 W0 C1 .
 2. Minimum Compressive Strength: **3000 psi** at 28 days.
 3. Maximum w/cm: 0.50.
 4. Minimum Cementitious Materials Content: **470 lb/cu. yd.**
 5. Slump Limit: **8 inches**, plus or minus **1 inch** for concrete with verified slump of **3 inches (75 mm)**, plus or minus **1 inch** , before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 6. Slump Flow Limit: **22 inches**, plus or minus **1.5 inches**.
 7. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd. , increase mixing time by 15 seconds for each additional 1 cu. yd. .
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- 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.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 2. Face laps away from exposed direction of concrete pour.
 3. Lap vapor retarder over footings and grade beams not less than **6 inches**, sealing vapor retarder to concrete.
 4. Lap joints **6 inches** and seal with manufacturer's recommended tape.
 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by **6 inches** on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Form keyed joints as indicated. Embed keys at least **1-1/2 inches** into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch**. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch-** wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: 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.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 2. Terminate full-width joint-filler strips not less than **1/2 inch** or more than **1 inch** below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of **ACI 301**, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. 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.

1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with **ACI 301**.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches** into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. **ACI 301** Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than **1-1/2 inches** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1 inch**.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: **ACI 117** Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. **ACI 301** Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1/4 inch**.
 - c. Patch tie holes.
 - d. Surface Tolerance: **ACI 117** Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

3. **ACI 301 Surface Finish SF-3.0:**
 - a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1/8 inch**.
 - c. Patch tie holes.
 - d. Surface Tolerance: **ACI 117 Class A**.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

- B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:
 1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

 2. Grout-Cleaned Rubbed Finish:
 - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.
 - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
 - f. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

 3. Cork-Floated Finish:
 - a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
 - b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - c. Wet concrete surfaces.
 - d. Compress grout into voids by grinding surface.
 - e. In a swirling motion, finish surface with a cork float.
 - f. Maintain required patterns or variances as shown on Drawings or to match design reference sample.

 4. Scrubbed Finish: After concrete has achieved a compressive strength of from **1000 to 1500 psi**, apply scrubbed finish.

- a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
- b. Rinse scrubbed surfaces with clean water.
- c. Maintain continuity of finish on each surface or area of Work.
- d. Remove only enough concrete mortar from surfaces to match design reference sample.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of **1/4 inch** in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with **ACI 117** tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view.
7. Finish surfaces to the following tolerances, in accordance with **ASTM E1155**, for a randomly trafficked floor surface:
 - a. Slabs on Ground:

- 1) Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, **10-ft.-long** straightedge resting on two high spots and placed anywhere on the surface does not exceed **1/4 inch**.
 - 2) Specified overall values of flatness, F_F 25; and of levelness, F_L 20; with minimum local values of flatness, F_F 17; and of levelness, F_L 15.
 - 3) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
 - 4) Specified overall values of flatness, F_F 45; and of levelness, F_L 35; with minimum local values of flatness, F_F 30; and of levelness, F_L 24.
 - 5) Specified Overall Value (SOV): F_F 50 and F_L 25 with minimum local value (MLV): F_F 40 and F_L 17.
 - 6) Specified Overall Value (SOV): F_F 25 and F_L 20 with minimum local value (MLV): F_F 17 and F_L 15.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
1. Coordinate required final finish with Architect before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread **25 lb/100 sq. ft.** of dampened slip-resistive aggregate over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of **100 lb/100 sq. ft.** unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 4. After final floating, apply a trowel finish.
 5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.9 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with **ACI 301** and **ACI 305.1** for hot-weather protection during curing.
 2. Maintain moisture loss no more than **0.2 lb/sq. ft. x h** before and during finishing operations.
- B. Curing Formed Surfaces: Comply with **ACI 308.1** as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with **ACI 308.1** as follows:
1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12-inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but 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 **12 inches**, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

- b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12 inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but 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 **12 inches**, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12 inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
- 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
- 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped **6 inches** and sealed in place.
- 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
- 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.10 TOLERANCES

- A. Conform to **ACI 117**.

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.

4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s).
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches** deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
1. Repair and patch defective areas when approved by Architect.
 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a **No. 16** sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch** in any dimension to solid concrete.
 - a. Limit cut depth to **3/4 inch**.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of **0.01 inch** wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of **1/4 inch** to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes **1 inch** or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a **3/4-inch** clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes **1 inch** or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.

- d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
 - F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides 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 C143/C143M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow: ASTM C1611/C1611M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of three laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of three field-cured specimens at seven 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.
 9. 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.
 10. 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 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 11. 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.
 12. Additional Tests:
 - a. 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.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.
 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 do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 05120
STRUCTURAL STEEL FRAMING

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. Structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

1.4 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Guam Memorial Hospital, Barrigada Guam..

1.6 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Anchor rods.
- B. 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 AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.
- D. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, professional engineer, and testing agency.
- B. Welding certificates.
- C. Mill test reports for structural-steel materials, including chemical and physical properties.
- D. Product Test Reports: For the following:
 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
- E. Survey of existing conditions.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 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 Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 341.
 - 3. ANSI/AISC 360.
- B. Connection Design Information:
 - 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Moment frame.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Angles: ASTM A36/A36M. Materials complying with first option in "Plate and Bar" Paragraph below are widely available; those complying with second option are less so. Third option is a specialty-steel material; verify availability if required.
- B. Plate: ASTM A36/A36M..

2.3 BOLTS AND CONNECTORS

- A. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
- B. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- D. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened..
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.6 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
4. 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.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- 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 on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates: 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. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in

permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened..

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a 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: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

- 1) Liquid Penetrant Inspection: ASTM E165/E165M.
- 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
- 3) Ultrasonic Inspection: ASTM E164.
- 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 09900
PAINTS AND COATINGS

PART 1 - GENERAL

1.01 SUBMITTALS

- A. Comply with the provision of Section 01300.
 - 1. Shop Drawings
 - a. Piping identification
 - 2. Product Data
 - a. Coating
 - b. Manufacturer's Technical Data Sheets
 - c. Sealant
 - 3. Certificates
 - a. Applicator's qualifications
 - 4. Manufacturer's Instructions
 - a. Application instructions
 - b. Mixing
 - c. Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.
 - d. Manufacturer's Material Safety Data Sheets
 - e. Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials
 - 5. Operation and Maintenance Data
 - a. Coatings
 - b. Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.02 APPLICATOR'S QUALIFICATIONS

- A. Contractor Qualification: Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

1. Name of individual and proposed position for this work.
2. Information about each previous assignment including:
3. Position or responsibility
4. Employer (if other than the Contractor)
5. Name of facility owner
6. Mailing address, telephone number, and telex number (if non-US) of facility owner
7. Name of individual in facility owner's organization who can be contacted as a reference
8. Location, size and description of structure
9. Dates work was carried out
10. Description of work carried out on structure

1.03 REGULATORY REQUIREMENTS

- A. Environmental Protection: In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.
- B. Lead Content: Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.
- C. Chromate Content: Do not use coatings containing zinc-chromate or strontium-chromate.
- D. Asbestos Content: Materials shall not contain asbestos.
- E. Mercury Content: Materials shall not contain mercury or mercury compounds.
- F. Silica: Abrasive blast media shall not contain free crystalline silica.
- G. Human Carcinogens: Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.04 PACKAGING, LABELING, AND STORAGE

- A. Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.05 SAFETY AND HEALTH

- A. Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal and local laws and regulations.

1. Safety Methods Used During Coating Application: Comply with the requirements of SSPC Guide 3.
2. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

1.06 ENVIRONMENTAL CONDITIONS

- A. Coatings: Do not apply coating when air or substrate conditions are:

1. Less than 5 degrees F above dew point;
2. Over 95 degrees F. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.07 COLOR SELECTION

- A. Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the GMHA Project Engineer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

- B. Tint each coat progressively darker to enable confirmation of the number of coats.

1.08 LOCATION AND SURFACE TYPE TO BE PAINTED

- A. Painting Included: Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

1. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
2. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
3. Existing coated surfaces that are damaged during performance of the work.

- B. Interior Painting: Includes existing coated surfaces made bare by cleaning operations.

- C. Painting Excluded: Do not paint the following unless indicated otherwise.

1. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

2. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.
 3. Steel to be embedded in concrete.
 4. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.
 5. Hardware, fittings, and other factory finished items.
- D. Mechanical and Electrical Painting: Includes field coating of interior and exterior new and existing surfaces.
1. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
 - a. Exposed piping, conduit, and ductwork;
 - b. Supports, hangers, air grilles, and registers;
 - c. Miscellaneous metalwork and insulation coverings.
 2. Do not paint the following, unless indicated otherwise:
 - a. New zinc-coated, aluminum, and copper surfaces under insulation
 - b. New aluminum jacket on piping
 - c. New interior ferrous piping under insulation
- E. Definitions and Abbreviations
1. Coating: A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.
 2. DFT or dft: Dry film thickness, the film thickness of the fully cured, dry paint or coating.
 3. EPP: Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.
 4. EXT: MPI short term designation for an exterior coating system.
 5. INT: MPI short term designation for an interior coating system.
 6. micron/microns: The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

7. mil/mils: The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.
8. Paint: See Coating definition.
9. REX: MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.
10. RIN: MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 - EXECUTION

3.01 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

- A. Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.02 REPUTTYING AND REGLAZING

- A. Remove cracked, loose, and defective putty or glazing compound on glazed sash and provide new putty or glazing compound. Where defective putty or glazing compound constitutes 30 percent or more of the putty at any one light, remove the glass and putty or glazing compound and reset the glass. Remove putty or glazing compound without damaging sash or glass. Clean rabbets to bare wood or metal and prime prior to reglazing. Putty for wood sash shall be linseed oil putty. Glazing compound for metal sash shall conform to ASTM C 669. Patch surfaces to provide smooth transition between existing and new surfaces. Finish putty or glazing compound to a neat and true bead. Allow glazing compound time to cure, in accordance with manufacturer's recommendation, prior to coating application. Allow putty to set one week prior to coating application.

3.03 SURFACE PREPARATION

- A. Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

1. Additional Requirements for Preparation of Surfaces with Existing Coatings: Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:
 - a. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.
 - b. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.
 - c. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.
 - d. Previously painted damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.
 - e. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.
 - f. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.
 - g. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.
 - h. Edges of chipped paint shall be feather edged and sanded smooth.
 - i. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.
 - j. New, proposed coatings shall be compatible with existing coatings.
2. Removal of Existing Coatings: Remove existing coatings from the following surfaces:
 - a. Surfaces containing large areas of minor defects;
 - b. Surfaces containing more than 20 percent peeling area; and
 - c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.
3. Substrate Repair
 - a. Repair substrate surface damaged during coating removal;
 - b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and
 - c. Clean and prime the substrate as specified.

3.04 PREPARATION OF METAL SURFACES

A. Existing and New Ferrous Surfaces

1. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash to remove oil and grease. Where shop coat is missing or damaged. Brush-off blast remaining surface. Water jetting may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
2. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface.

B. Final Ferrous Surface Condition:

1. For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.
2. For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.
3. For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

C. Galvanized Surfaces

1. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized". If the absence of hexavalent stain inhibitors is not documented, test and remove by one of the methods described therein.
2. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.
3. Galvanized with Severe Deteriorated Coating or Severe Rusting: Spot abrasive blast rusted areas and waterjet to remove existing coating.

D. Non-Ferrous Metallic Surfaces: Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

1. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

E. Existing Surfaces with a Bituminous or Mastic-Type Coating: Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup

household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.05 APPLICATION

A. Coating Application

1. Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.
2. At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.
3. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.
4. Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.
5. Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.
6. Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.
7. Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.
 - a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
 - b. Primers and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely and there shall be a visually perceptible difference in shades of successive coats.
 - c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
 - d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

B. Mixing and Thinning of Paints

1. Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.
2. When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

C. Two-Component Systems

1. Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

D. Coating Systems

1. **Minimum Dry Film Thickness (DFT):** Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
2. **Coatings for Surfaces Not Specified Otherwise:** Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
3. **Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces:** Coat surfaces with the following:
 - a. One coat of primer.
 - b. One coat of undercoat or intermediate coat.
 - c. One topcoat to match adjacent surfaces.
4. **Existing Coated Surfaces To Be Painted:** Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.06 COATING SYSTEMS FOR METAL

A. Apply coatings as follows.

1. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
2. **Inaccessible Surfaces:** Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

3. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
4. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.
5. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
6. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.07 PIPING IDENTIFICATION

- A. Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with ANSI A13.1. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, ANSI A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.08 PAINT TABLES

A. EXTERIOR STEEL / FERROUS SURFACES

1. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

Alkyd

New; MPI EXT 5.1Q-G5 (Semigloss)/Existing; MPI REX 5.1D-G5

Primer: Intermediate: Topcoat:

MPI 23 MPI 94 MPI 94

System DFT: 5.25 mils

New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer: Intermediate: Topcoat:

MPI 23 MPI 9 MPI 9

System DFT: 5.25 mils

2. New Steel that has been blast-cleaned to SSPC SP 6:

Alkyd

New; MPI EXT 5.1D-G5 (Semigloss)/Existing; MPI REX 5.1D-G5

Primer: Intermediate: Topcoat:

MPI 79 MPI 94 MPI 94

System DFT: 5.25 mils

New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6

Primer: Intermediate: Topcoat:

MPI 79 MPI 9 MPI 9

System DFT: 5.25 mils

3. Existing steel that has been spot-blasted to SSPC SP 6:

Surface previously coated with alkyd or latex:

Waterborne Light Industrial Coating
MPI REX 5.1C-G5 (Semigloss)
Spot Primer: Intermediate: Topcoat:
MPI 79 MPI 110-G5 MPI 110-G5
System DFT: 5 mils

MPI REX 5.1C-G6 (Gloss)
Spot Primer: Intermediate: Topcoat:
MPI 79 MPI 110-G6 MPI 110-G6
System DFT: 5 mils

Surface previously coated with epoxy:

Waterborne Light Industrial
MPI REX 5.1L-G5 (Semigloss)
Spot Primer: Intermediate: Topcoat:
MPI 101 MPI 110-G5 MPI 110-G5
System DFT: 5 mils

MPI REX 5.1L-G6 (Gloss)
Spot Primer: Intermediate: Topcoat:
MPI 101 MPI 110-G6 MPI 110-G6
System DFT: 5 mils

Pigmented Polyurethane
MPI REX 5.1H-G6 (Gloss)
Spot Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 72
System DFT: 8.5 mils

4. New and existing steel blast cleaned to SSPC SP 10:

Waterborne Light Industrial

MPI EXT 5.1R-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 110-G5
System DFT: 8.5 mils

MPI EXT 5.1R-G6 (Gloss)

Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 110-G6
System DFT: 8.5 mils

Pigmented Polyurethane

MPI EXT 5.1J-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 72
System DFT: 8.5 mils

B. Insulation and surfaces of insulation coverings (canvas, cloth, paper): (Interior and Exterior Applications)

1. Latex

MPI EXT 10.1A-G1 (Flat)

Primer: Intermediate: Topcoat:
N/A MPI 10 MPI 10

System DFT: 3.2 mils

MPI EXT 10.1A-G5 (Semigloss)

Primer: Intermediate: Topcoat:
N/A MPI 11 MPI 11

System DFT: 3.2 mils

MPI EXT 10.1A-G6 (Gloss)

Primer: Intermediate: Topcoat:
N/A MPI 119 MPI 119

System DFT: 3.2 mils

Topcoat: Coating to match adjacent surfaces.

C. INTERIOR STEEL / FERROUS SURFACES

1. Metal, Mechanical, Electrical, including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

High Performance Architectural Latex

MPI INT 5.1R-G2 (Flat)

Primer: Intermediate: Topcoat:
MPI 79 MPI 138 MPI 138

System DFT: 5 mils

MPI INT 5.1R-G3 (Eggshell)

Primer: Intermediate: Topcoat:
MPI 79 MPI 139 MPI 139

System DFT: 5 mils

MPI INT 5.1R-G5 (Semigloss)

Primer: Intermediate: Topcoat:
MPI 79 MPI 141 MPI 141

System DFT: 5 mils

Alkyd

MPI INT 5.1E-G2 (Flat)

Primer: Intermediate: Topcoat:
MPI 79 MPI 49 MPI 49

System DFT: 5.25 mils

MPI INT 5.1E-G3 (Eggshell)

Primer: Intermediate: Topcoat:
MPI 79 MPI 51 MPI 51

System DFT: 5.25 mils

MPI INT 5.1E-G5 (Semigloss)

Primer: Intermediate: Topcoat:
MPI 79 MPI 47 MPI 47
System DFT: 5.25 mils

MPI INT 5.1E-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 48 MPI 48
System DFT: 5.25 mils

END OF SECTION

SECTION 15000

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 APPLICATION

- A. This section applies to all Section 15401 of Division 15.

1.2 LAWS, REGULATIONS AND CODES

- A. All work shall be in accordance with government laws, ordinances, rules, regulations, and orders.
- B. The Following Shall Govern Where Applicable: The 2019 International Building Code, The 2009 International Plumbing Code, The 2009 International Mechanical Code, OSHA Rules and Regulations, and all other codes and standards referenced in these specifications. Where requirements differ in these codes and standards, the more stringent shall apply.

1.3 TRADE NAMES

- A. Mentioning of a trade name indicates that the manufacturer is acceptable to the Engineer. However, certain specified construction and details may not be regularly included in the manufacturer's catalogued product. The Mechanical Contractor shall provide the material or equipment complete as specified.

1.4 AVAILABILITY OF EQUIPMENT AND MATERIALS

- A. Specified equipment and materials may not be available locally and must be ordered off-island. This does not give Contractor the option to substitute non-complying materials or equipment that is locally available.

1.5 DEFINITIONS

- A. "As directed" shall mean that the Mechanical Contractor shall seek instructions of the Contracting Officer.
- B. "As indicated" shall mean as shown on plans.
- C. "As necessary" shall mean that the item shall be provided if necessary to have all systems complete, tested, and ready for operation.
- D. "Furnish" shall mean that the Mechanical Contractor shall furnish item indicated, installation will be done under another work.
- E. "Provide" shall mean the Mechanical Contractor shall furnish and install item indicated.
- F. "Or approved equal" used after a trade name shall mean that the trade name mentioned will be used as a basis of comparison and that all makes of similar item will be considered, provided that, in the opinion of the Contracting Officer, substituted item has equal or better quality than the trade name mentioned.
- G. "Or approved equivalent as manufactured by" shall mean that only products of manufacturers mentioned in the paragraph are acceptable to the Contracting Officer.

1.6 SUBMITTALS

- A. Submit six sets of shop drawings, manufacturer's data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication, or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry, and technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish.
1. **Shop Drawings:** Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, isometric piping, and installation details identifying and indicating proposed location, layout and arrangement of piping and other items that must be shown to assure a workable installation. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating devices.
 2. **Manufacturer's Data:** Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.
 3. **Standards Compliance:** When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories (UL), proof of such conformance shall be submitted to the Engineer for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections.
 4. **Certificates of Conformance or Compliance:** Submit certification from the manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certification will not be acceptable; certifications shall be in the original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified.
- B. Each submittal shall bear Contractor's Certification that the material, equipment, and other items in the submittal are in compliance with Contract Drawings and Specifications can be installed in allocated spaces.
- C. Any submittal without Contractor's Certification will be returned without review.

1.7 DELIVERY AND STORAGE

- A. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation. Damaged or defective items shall be replaced.

1.8 CATALOGED PRODUCTS

- A. Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number, and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 SAFETY REQUIREMENTS

- A. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified herein.

1.10 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.11 AS-BUILT DRAWINGS

- A. The Contractor shall maintain at the site one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders, and other modifications, in good order and marked to record all changes made during construction. These shall be made available to the GMHA Project Manager.
- B. At the conclusion of the work, the Mechanical Contractor will be furnished by the Contracting Officer, at the Mechanical Contractor's expense, a set of AutoCAD electronic tiles, made from original contract plans. The Mechanical Contractor shall then incorporate all changes made, as recorded. The GMHA Project Manager shall approve as-built drawings. As a condition for acceptance of work, "as-built" reproducible shall be signed by Mechanical Contractor attesting that all changes have been incorporated, dated and delivered to the GMHA Project Manager. Include 3 sets of prints of as-builts.

1.12 OPERATION AND MAINTENANCE MANUALS

- A. Upon completion of the project, and as a condition of its acceptance, deliver the GMHA Project Engineer 3 sets of operations and maintenance manual and specifications of all other items requiring maintenance. Include manufacturer's addresses and contact numbers.

1.13 SPARE PARTS

- A. Provide 1 spare pressure relief valve of each size, 1 spare pressure reducing valve of each size and 1 spare gage. Provide 1 spare valve for each size larger than 2". Deliver to GMHA Project Engineer at the conclusion of the project.

--END OF SECTION --

SECTION 15401

BOILER, STEAM, CONDENSATE AND VENT PIPING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Work included: The Work includes boiler, steam, condensate, and vent, and all other items indicated on the Drawings or described in these Specifications, plus all other items needed for a complete and proper installations. The work also includes connections to existing equipment.
- B. The work to be performed consists of providing all labor, equipment, materials, etc. to remove existing and provide new factory assembled steam boiler(s) as described in the specifications herein.

1.2 QUALITY ASSURANCE

- A. Use sufficient journeyman, pipe fitters, certified welders, and competent supervisors in execution of this Work to ensure proper and adequate installation throughout. In the acceptance or rejection of installed work, no allowance will be made for lack of skill on the part of workmen.
- B. The equipment shall, as a minimum, be in strict compliance with the requirements of this specification and shall be the manufacturer's standard commercial product unless specified otherwise. Additional equipment features, details, accessories, appurtenances, etc. which are not specifically identified but which are a part of the manufacturer's standard commercial product, shall be included in the equipment being furnished.
- C. The equipment shall be of the type, design, and size that the manufacturer currently offered for sale and appears in the manufacturer's current catalogue. The equipment shall be new and fabricated from new materials and shall be free from defects in materials and workmanship.
- D. The equipment must fit within the allocated space, leaving ample allowance for maintenance and cleaning, and must leave suitable space for easy removal of all equipment appurtenances. Tube pull clearance space from either the front or rear of boiler must be maintained.
- E. All units of the same classification shall be identical to the extent necessary to insure interchangeability of parts, assemblies, accessories, and spare parts wherever possible.
- F. In order to provide unit responsibility for the specified capacities, efficiencies, and performance, the boiler manufacturer shall certify in writing that the equipment being submitted shall perform as specified. The boiler manufacturer shall be responsible for guarantying that the boiler provides the performance as specified herein.

1.3 REFERENCES

- A. **Product Data:** Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.
- B. **Shop Drawings:** Detail equipment assemblies and indicate dimensions, required clearances, and method of field assembly, components, and location and size of each field connection.
- C. **Wiring Diagrams:** Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- D. **Source Quality Control Tests and Inspection Reports:** Indicate and interpret test results for compliance with performance requirements before shipping.
- E. **Field Test Reports:** Indicate and interpret test results for compliance with performance requirements.
- F. **Maintenance Data:** Include in the maintenance manuals specified in Division 1. Include parts list, maintenance guide, and wiring diagrams for each boiler.
 - 1. ASME Section (I or IV) (Power boilers or Heating Boilers)
 - 2. ANSI Z21.13 (Gas Fired Low Pressure Boilers)
 - 3. NFPA 54 (ANSI Z221.3) National Fuel Gas Code
 - 4. FACTORY MUTUAL
 - 5. ASME CSD-1 (Controls and Safety Devices)
 - 6. IRI (Industrial Risks Insurance)
 - 7. UBC (Uniform Building Code)
 - 8. UMC (Uniform Mechanical Code)
 - 9. NEC (National Electrical Code)
 - 10. UL (Underwriters Laboratories)
 - 11. NFPA 85

1.4 SUBMITTALS

- A. **General:** Comply with the provisions of Section 15000.
- B. **Product Data:** Within 35 calendar days after award of Contract, submit:
 - 1. Catalog cuts and other data required to demonstrate compliance with the specified requirements shall be provided for the following:
 - A. Boiler
 - B. Insulation
 - C. Pipes and Fittings
 - D. Valves

1.5 CERTIFICATIONS

- A. **Manufacturer's Certification:** The boiler manufacturer shall certify the following:
1. The products and systems furnished are in strict compliance with the specifications.
 2. The boiler, burner and other associated mechanical and electrical equipment have all been properly coordinated and integrated to provide a complete and operable boiler.
 3. ASME certification.
 4. UL and CSD-1 certification.
 5. The equipment furnished has been installed in accordance with the manufacturer's installation instructions.
 6. The specified factory tests have been satisfactorily performed.
 7. The specified field tests have been satisfactorily performed.
- B. **Contractor's Certification:** The contractor shall certify the following:
1. The products and systems installed are in strict compliance with the specifications.
 2. The specified field tests have been satisfactorily performed.
- C. **Boiler Inspectors' Certification:** All boiler inspections during hydrostatic testing shall be performed by an authorized boiler inspector who is certified by the National Board of Boiler and Pressure Vessel Inspectors and shall be submitted in writing prior to final acceptance by the engineer.
- D. **Test Reports:** Factory and field test reports as described above and as specified hereinafter, shall be submitted prior to final acceptance by the engineer.
- E. **Operation and Maintenance Manuals:** Manufacturer's printed operation and maintenance manuals shall be submitted prior to final acceptance by the engineer. Operation and maintenance manuals shall contain shop drawings, product data, operating instructions, cleaning procedures, replacement parts list, maintenance and repair data, complete parts list, etc.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. The contractor shall be responsible for the timely delivery of the equipment to the job site. The contractor shall be responsible for unloading and rigging of the equipment. The contractor shall be responsible for protecting the equipment from the weather, humidity and temperature conditions, dirt, dust, other contaminants, as well as job site conditions during construction.
- B. Equipment shall be unloaded, handled, and stored in accordance with the manufacturer's handling and storage instructions.

- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Contracting Officer and at no additional cost to the Government.

1.7 WELDING SAFETY

- A. Comply with American Welding Society (AWS) Z49.1, Safety in Welding, Cutting and Allied Process.

1.8 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect the materials of this Section before, during, and after installation and to protect existing systems.

PART 2 - PRODUCTS

2.1 GENERAL BOILER DESIGN

- A. Design shall be optimized using CFD modeling verifiable by manufacturer. The boiler shall be a multi-pass horizontal firetube updraft boiler using extended heating surface optimized to reduce boiler footprint. Boiler shall be mounted on a heavy steel frame with integral forced draft burner and burner controls.

1. The packaged boiler shall be completely preassembled and fire tested at the factory. The unit shall be ready for immediate mounting on floor or simple foundation and ready for attachment of water, fuel, electrical, vent, and blowdown connections.
2. The boiler shall be built to comply with the following insurance and codes: (Factory Mutual, XL GAPS, ASME, NFPA 85).

- B. Boiler Shell (Steam)

1. The boiler shell must be constructed in accordance with ASME Boiler Code and must receive authorized boiler inspection prior to shipment. A copy of the inspection report shall be furnished to the purchaser.
2. The boiler shall be furnished with a manhole and handholes to facilitate inspection and cleaning. Two lifting lugs must be located on top of the boiler.
3. The front smokebox doors shall be davited and sealed with superwool insulation and fastened tightly using locking lugs on steel studs.
4. The rear head shall be fitted with an access plug for rear fireside inspection.
5. The boiler tubes shall not include turbulators, swirlers, or other add-on appurtenances.
6. The exhaust gas vent shall be located at the front of the boiler and the boiler shall be furnished with a manhole and hand-holes to facilitate boiler capable of supporting 2000 lbs. The boiler vent shall contain a stack thermometer.
7. Observation ports for the inspection of flame conditions shall be provided at each end of the boiler.
8. The boiler insulation shall consist of 2 inch blanket under a sectional pre-formed sheet metal lagging. The insulation must be readily removable and capable of being reinstalled if required.
9. The entire boiler base frame and other components shall be factory painted before shipment, using a hard-finish enamel coating.
10. The boiler shall contain a chemical feed connection.

2.2 STEAM BOILER TRIM

- A. Water Column/low Water Cutoff and Water Level Control System shall be a CB LEVE MASTER water level control system and shall comprise a microprocessor- based electronic controller, a non-contact, non-wearing, continuously reading absolute level sensor, and pressure chamber. The control system shall be designed as follows: The electronic controller shall be mounted in the common control panel and operate in ambient temperatures from 32 degrees F to 125 degrees F. The pressure chamber shall be boiler mounted and operate to pressures of 250 PSIG and the level sensor shall operate to pressures of 250 PSIG and temperatures to 400 degrees F. The pressure-containing components shall be constructed in accordance with ASME Code. A shielded, four conductor cable with ground shall be run in metal conduit between the level sensor and the controller. Supply power shall be 115VAC-1 phase- 60 Hz. All wiring shall be in compliance with the National Electrical Code. The pressure chamber shall have a sight glass mounted on the side. The level sensor shall have an accuracy of .01" or greater. The electronic controller shall have level and error indicating lights, alphanumeric display for messaging, reset/ menu switch and the following features:
- a. Continuous Level Indication
 - b. Low Water Cutoff & Alarm
 - c. High Water Alarm
 - d. Low & High Water Warning
 - e. Full Modulating Control of Modulating Feedwater Control Valve
 - f. Continuous Monitoring of Float Operation
 - g. Column Blowdown Detection and Reminder
 - h. Auto or Manual Reset
 - i. Real Time Clock
 - j. Alarm Annunciation
 - k. Alarm History Files with Time Stamp
 - l. Water Column Blowdown Record
 - m. Auxiliary Low Water Cutoff Check
 - n. RS 232 Interface Maximum contacts rating 15 amps resistive load
- B. Modulating feedwater control - Modulating feedwater control and valve shall be included to automatically maintain the boiler water level within normal limits.
- C. Auxiliary low water cut-off - Auxiliary low water cut-off shall be included, piped to the vessel, and wired to the burner control circuit. A manual reset device shall be used on this control.
- D. Steam Pressure Gauge - The steam pressure gauge shall be located at the front of the boiler and include cock and test connection.
- E. Safety Valves - Safety valves of a type and size to comply with ASME Code requirements shall be shipped loose.
- F. Steam Pressure Controls - the steam pressure control to regulate burner operation shall be mounted near the water column. Controls shall be a high limit (manual reset), operating limit (auto reset) and firing rate control.

2.3 BURNER

- A. Burner shall incorporate Cleaver Brooks "Lean Burn Technology".
- B. Fuel and air ratio/mixture shall be controlled over the entire operating range, allowing for firing at application.
- C. Burner to be designed specifically for boiler including optimized furnace allowing for low emissions and lean burn combustion.
- D. Mode of Operation

1. Burner operation shall be full modulation principle. The burner shall always return to low fire position for ignition.
2. A low fire hold temperature control is mounted and wired on the boiler.

2.4 BLOWER

1. Air for combustion shall be supplied by a forced draft blower incorporated into the burner design, to eliminate vibration and reduce noise level.
2. The impeller shall be fabricated steel with radial blade, carefully balanced, and directly connected to the blower motor shaft.
3. Mount blower integral to burner to permit unrestricted access to combustion chamber.

2.5 Combustion Air Control - Combustion air damper and fuel metering valve shall be operated by individual actuators to regulate the flame according to load demand.

2.6 Oil Burners - Fuel Series 100 (Light Oil-Fired) and 200 (Light Oil or Gas-Fired)

1. Burner type - The burner shall be mounted at the front of the boiler and shall be a low pressure air atomizing type approved for operation with CS12-48 Commercial No. 2 oil.
2. Gas Pilot - The gas pilot shall be a premix type with automatic electric ignition. An electronic detector shall monitor the pilot so that the primary oil valve cannot open until pilot flame has been established. The pilot train shall include one manual shut-off valve, solenoid valve, pressure regulator and one (1) plugged leakage test connection (Canada only).
3. Oil Pump - An oil pump with a capacity of approximately twice the maximum burning rate shall be included. The motor-driven pump set, shipped loose, to be installed in a location favorable to the oil storage tank, shall be provided.
4. Oil Burner Piping - Fuel oil piping on the unit shall include oil pressure regulating devices, oil metering controls, low oil pressure switch, two (2) motorized oil valves and pressure gauges, all integrally mounted on the unit.

2.7 BOILER CONTROLS AND CONTROL PANEL

1. Control/Entrance Panel - A common enclosure shall house the control panel and the entrance panel. Enclosure shall be NEMA 4/12 rated and shall be mounted at the side of the boiler in a location convenient to the operator. Enclosure shall consist of upper and lower sections divided by a partition with a separate hinged door for each section. Upper section (low voltage) will house boiler controls including flame safeguard and water level system controller. Lower panel section (high voltage) will house entrance panel.
2. Cleaver Brooks Combustion Control System - Hawk system with parallel positioning with separate actuators for each fuel and combustion air shall be used to provide proper fuel air ratio control.
3. CB780E Flame Safeguard - Each boiler shall be factory equipped with flame safeguard controller incorporated into the Hawk control. Oil, heat and moisture resistant wire shall be used and identified with circuit numbers corresponding to the electrical wiring diagram. Boiler to be supplied with a control circuit

transformer and fuse protection for the control circuit.

2.8 PIPE

- A. Steam Piping from Boiler to Pressure Reducing Valves at Steam Manifold: Schedule 80 black steel pipe conforming to ASTM A106 with butt welding steel fittings ASME 16.9 on flanged fittings ASME 16.5.
- B. All Other Steam, Vent, and Drain Piping: Schedule 40 Black steel pipe conforming to ASTM A53 or ASTM A106 with 150 psi malleable iron screwed fittings conforming to ANSI 16.3 for pipes 2 inches and smaller, butt welding steel fittings ASME 16.9 or flanged fittings ASME 16.5. Use flanged fittings for 2" and smaller pipes where shown on plans.

2.9 VALVES

- A. Steel Gate Valves: ASME B16.34. Provide outside screw and yoke type with solid wedge or flexible wedge disc, and with trim suitable for the service temperature and pressure for pipes bigger than 3 inches.
- B. Globe Valves: Bronze Globe Valves: MSS SP-80, Type 3 (metal disc, renewable seat), 3 inches and smaller, flanged or threaded joint or as indicated, Class 200.
- C. Pressure Reducing Valves: ASTM A536 ductile iron bodies, 301 stainless steel diaphragms with 420 stainless steel seats, 150 psig inlet pressure.
- D. Pressure Relief Valves: Angle configuration, flanged ends ASTM A126, Class B cast iron body, cast iron spring chamber, 302 stainless steel spring, metal seat and diaphragm.

2.10 STRAINERS

- A. Federal Specifications (FS) WW-S-2739, Style Y (Y pattern) for Class 125 piping in sizes ½ to 8 inches, inclusive, locate as indicated, cast iron prohibited.

2.11 PRESSURE GAGES

- A. ASME B40.1 with restrictor, locate as indicated. Provide scale range for intended service. Scale range not to exceed two times (2X) the indicated pressure of piping.

2.12 PIPE SLEEVES AND ESCUTCHEONS

- A. All pipe sleeves and escutcheons shall be steel pipe and shall have ample clearance for pipe and covering, and shall have chrome plated wall and floor escutcheons over the pipe n finished areas.

2.13 STEAM TRAPS

- A. Float and Thermostatic Type, 150 psig, ASTM Class 30 body and cap, 304 stainless steel internals, 440 stainless steel valve, 305 stainless steel seat, stainless steel and bronze with phosphor bronze bellows. Provide complete with integral vacuum breaker, 150 psig.

2.14 HANGERS AND SUPPORTS

- A. Hangers and supports shall equal or exceed the quality of the following:

- | | <u>Item</u> | <u>Manufacturer and Number</u> |
|------|---|--------------------------------|
| | 1. Clevis Type Hanger | Grinnell Fig. 260, galvanized. |
| B. | Hanger rods shall be galvanized, sizes as indicated. | |
| 2.15 | ISOLATION | |
| A. | Isolate all dissimilar metals with dielectric flanges. | |
| 2.16 | STEAM, CONDENSATE, AND VENT PIPING INSULATION | |
| A. | Premolded, sectional high temperature calcium silicate insulation ASTM C533 Product of Owens-Corning" or "Johns-Manville. Insulation thickness shall be 2" for pipes 1-1/4" and smaller, 2-1/2" thick for pipes 1-1/2" to 3", and 3" thick for pipes bigger than 3". Cover insulation with glass cloth, smoothly adhered with lagging adhesive. | |
| 2.17 | OTHER MATERIALS | |
| A. | All other materials, not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds, and as selected by the Contractor subject to the approval of the GMHA Project Engineer. | |

PART 3 – EXECUTION

3.1 EXAMINATION

- I. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and flue; piping; controls; and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 1. Boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for flue, piping, controls, and electrical connections.
- J. Examine areas where boilers will be installed for suitable conditions.

3.2. BOILER INSTALLATION

- A. Coordinate size and location of bases. Cast anchor-bolt inserts into concrete bases.
- B. Equipment Mounting:
 1. Comply with requirements for vibration isolation and seismic-control devices as per manufacturer publish installation manuals.
 2. Retain first paragraph below for gas-fired boilers.
- C. Install oil-fired boilers according to NFPA 31.
- D. Assemble and install boiler trim, components, and accessories that are not factory installed.

- E. Install control and electrical devices furnished with boiler that are not factory mounted.
- F. Install control and power wiring to field-mounted control and electrical devices furnished with boiler that are not factory installed.
- G. Perform boil-out and cleaning procedures according to manufacturer's written instructions after completion of hydrostatic testing and before performing other field tests. Following boil-out and cleaning procedures, boiler shall be washed and flushed until water leaving boiler is clear.
- H. Protect boiler fireside and waterside from corrosion.
 - 1. Before boiler is filled with water, protect by dry storage method recommended by boiler manufacturer.
 - 2. After boiler is filled with water, and left not fired for more than 10 days, protect by wet storage method recommended by boiler manufacturer.
 - 3. Chemical Treatment: Quality of water in boilers shall be maintained by a professional water-treatment organization that shall provide on-site supervision to maintain the required water quality during periods of boiler storage as well as during operating, standby, and test conditions.

3.3 PIPING CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Where installing piping adjacent to boiler, allow space for service and maintenance.
- D. Connect oil piping to oil-train connection with dirt leg, shutoff valve, and union. Piping shall be at least full size of oil-train connection. Provide a reducer if required. Provide drain valve with threaded plug at piping low point.
- E. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- F. Connect steam and condensate piping to supply-, return-, and blowdown-boiler connections with union or flange at each connection. Provide each connection with shutoff valve if shutoff valves are not factory furnished with boiler trim.
- G. Connect feedwater piping to inlet- and discharge-flue-gas economizer connections with union or flange at each connection. Provide each connection with shutoff valve and other accessories indicated and recommended by manufacturer.
- H. Install piping from safety relief valves to nearest floor drain.
- I. Install piping from safety valves and drip-pan elbows. Extend piping from safety valves and terminate to vent outdoors. Extend piping from drip-pan elbow drain to nearest floor drain.

- J. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- K. Hot equipment drains connected to sanitary drainage system shall be cooled before discharging into the system if required to comply with more stringent of governing code requirements and requirements indicated.
- L. Connect chemical-treatment piping to each boiler chemical-treatment connection with check valve and isolation valve.

3.4 FLUE CONNECTIONS

- A. Connect breeching to full size of boiler outlet.
- B. Install flue-gas recirculation duct from vent to burner if not factory furnished and installed.
- C. Install easily accessible test ports for field testing of flue gas from each boiler.
- D. Install flue-gas economizer with factory-furnished transitions to connect to boiler and to field-installed breeching.

3.5 CONTROLS CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between boilers and other equipment to interlock operation as required, to provide a complete and functioning system.

3.6 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 with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Hydrostatic Leak Test: Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.

- b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature steam pressure.
 - c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Boiler will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. 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.
- G. Performance Tests:
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 - 2. Boilers shall comply with performance requirements indicated, as determined by field-performance tests. Adjust, modify, or replace equipment in order to comply.
 - 3. Perform field-performance tests to determine the capacity and efficiency of boilers.
 - a. Test for boiler efficiency at low fire, 10, 20, 30, 40, 50, 60, 70, 80, 90, and high fire 100 percent of full capacity. Determine and document efficiency at each test point.
 - b. For boilers equipped with flue-gas economizers, perform tests with and without flue-gas economizer operating.
 - 4. Test each safety valve. Record pressure at valve blowdown and reset. Test valve(s) with boiler operating at full capacity to ensure valve has capacity to prevent further rise in pressure.
 - 5. For boilers equipped with automatic oxygen trim control, conduct tests with automatic oxygen trim control on manual at zero trim and record performance. Repeat tests with automatic oxygen trim control under automatic control and record performance.
 - 6. Repeat tests until results comply with requirements indicated.
 - 7. Provide measurement and analysis equipment required to determine performance.
 - 8. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
 - 9. Document test results in a report and submit with informational submittals

3.7 PIPING

- A. Work material and equipment into a complete, convenient, and economical systems; and provide apparatus, parts, materials, and accessories which are necessary to accomplish this result.
 - 1. Piping: Fabricate, assemble, weld, and install piping and pipe system in accordance with ASME B31.1 and as further qualified herein. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established, for the work shown, by the Contractor, and work into place without

springing or forcing. Locate piping within buildings entirely out of the way of lighting fixtures, conduit, and doors, and other openings. Run overhead piping in buildings in the most inconspicuous positions. Provide adequate clearances from walls, and floors to permit the welding of joints; at least 6 inches for pipe sizes 4 inches and smaller, 10 inches for pipe sizes larger than 4 inches, and in corners provide sufficient clearance to permit the welder to work in between the pipe and one wall. Make provision for expansion and contraction of pipelines. Do not insulate piping until it has been inspected, tested, and approved. Where pipe passes through building structure, do not conceal pipe joints, but locate where they may be readily inspected and not weaken building structure. Run insulated pipe as required with sufficient clearance to permit application of insulation. Use flanged joints only where necessary for normal maintenance and where required to match valves and equipment. Gaskets, packing, and thread compounds shall be suitable for the service. Apply joint compound or tape on male thread only. Use long radius ells wherever possible to reduce pressure drops. Mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction shall not be used. Make branch connections with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.1 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Run piping as indicated, and avoid interference with other piping, conduit, or equipment. Run vertical piping plumb and straight and parallel to walls, except where specifically shown otherwise. Do not trap lines. Use reducing fittings for changes in pipe sizes. The use of bushings is prohibited. In horizontal lines 2 ½ inches and larger, use reducing fittings of the eccentric type to maintain the bottom of the lines in the same plane for steam lines and to maintain the top of the lines in the same plane for condensate lines except where a trap or pocket would result. Provide suitable size sleeves for lines passing through building structure. Install piping connected to equipment to provide flexibility for thermal stresses and for vibration. Support and anchor pipe so that strain from weight and thermal movement of piping is not imposed on the equipment. Thoroughly clean each section of pipe, fittings, and valves of foreign matter before erection. Before placing in position, clean the inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter; pipe 2 inches and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to the apparatus, thoroughly wash out the piping interior with water. Blow out steam piping compressed air, removing rust, oil, chips, sand, and other material. Plug or cap open ends of mains during shutdown periods. Do not leave lines open at any place where any foreign matter might accidentally enter pipe.

B. Welding:

1. **Welding of Piping:** Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and preparation and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually examined and meet acceptance standards indicated in Chapter VI of ASME B31.1.
2. **Quality of Welds:** Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.
3. **Arc Welding and Gas Welding:** In accordance with ASME BPVC SEC IX.

- C. Hangers and Supports: Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58. Continuous inserts and expansion bolts maybe used.
- D. Grading and Venting of PipeLines: Unless otherwise indicated, install horizontal lines of steam piping to grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction. When counter flow of condensate within the steam pipe occurs in a portion of a pipeline, pitch up in the direction of steam flow a minimum of 6 inches per 100 feet and increase pipe diameters by one standard pipe size. Steam mains pitched away from the boiler shall contain drip connection and air vent valves at the extreme end. Air vents shall be provided at the highest point of any vertical riser. Drip connection shall not be interconnected above the water line of the boiler.
- E. Pipe Sleeves: Provide pipe sleeves where pipes and tubing pass through masonry or concrete walls, roofs, and partitions. Use Schedule 40 galvanized steel pipe sleeves in outside walls below and above grade, in floor, and in roof slabs. Sleeves in partitions shall be zinc-coated sheet steel having a weight of not less than 4.43 kg per square meter 0.907 psf. Space between pipe, tubing, or insulation and the sleeve shall not be less than 1 inch. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Pack space between the pipe or tubing and the sleeve firmly with oakum and caulk both ends of the sleeves with elastic cement.
- F. Wall and Ceiling Plates: Secure plates to the pipe with enough clearance for thermal expansion of pipe. Use chromium-plated steel or nickel-plated cast iron plates on pipes passing through floors and partitions of toilet rooms and where indicated; use painted cast iron, malleable iron, or steel for all other plates.
- G. Flashing for Buildings: Provide tight waterproof flashing where pipes pass through building roofs and outside walls.
- H. Union and Flanges: Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus. Provide a union for each threaded end valve. Use unions on piping smaller than 2 inches in diameter and use flanges on piping 2 inches and larger in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections. Dielectric fittings shall utilize a non-metallic filler which will prevent current flow. The spacer shall be suitable for the pressure and temperature of the service. The fittings shall otherwise conform to the requirements of paragraph entitled "Fittings."
- I. Trap and Connections: Traps shall be of the type and capacity for the service and shall be properly supported and connected. Install traps with a dirt pocket and strainer between it and the piping or apparatus it drains. When necessary to maintain in continuous service apparatus or piping which is to be drained, provide a three-valve bypass so that the trap may be removed and repaired and condensate may drain through the throttled bypass valve. Provide a check valve on the discharge side of the trap whenever the trap is installed for lift or operating against a back pressure, or discharges into a common return line. When a thermodynamic trap is used, a check valve is not required or recommended. Provide test connections on the discharge side of the high and medium pressure traps when they are specifically required. The test connection shall include a 1/2 inch globe valve with uncapped nipple.

J. Valves

1. Install valves in conformance with ASME B31.1, ASME BPVC SEC VIII D1, and as required herein, at the locations indicated and elsewhere as required for the proper functioning of the system. Use gate valves unless otherwise indicated. Install stop valves in the supply lines equipped or located so as to permit operation from floor level, or provided with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair. Provide gate valves 200 mm 8 inches and larger with globe-valved bypass in accordance with MSS SP-45.
2. Steam Pressure-Reducing Valves: Provide the steam line entering each pressure-reducing valve with a strainer. Provide each pressure-reducing valve unit with two cutout valves and with a globe bypass valve and bypass piping. Provide each pressure-reducing valve unit with an indicating steam gage to show the reduced pressure, and a safety valve on the low pressure side with sufficient capacity to relieve the high pressure steam.
3. Safety Valves: Provide with drip pan elbows.

K. Pressure Gages: Install a shutoff valve or petcock between each pressure gage and the line, and gages on steam lines shall have a syphon installed ahead of the gage.

L. Cleaning of System: As installations of the various system components are completed, clean before final closing. Remove foreign matter from equipment and surrounding areas. Preliminary or final tests shall not be performed until the cleaning is approved.

M. Identification of Piping: Labels for pipes 3/4 inch diameter and larger shall bear printed legends to identify contents of pipes and arrows to shown direction of flow. Labels shall have color coded background to signify levels of hazard in accordance with ANSI A13.1. Legends and type and size of characters shall also conform as ANSI A13.1. Make labels of plastic sheet FS A-A-1689 with pressure sensitivity suitable for the intended applications, or they may be premolded of plastic to fit over pipe. For pipe smaller than 3/4 inch diameter, provide brass identification tags 40 mm 1 1/2 inches in diameter with legends in depressed black filled characters.

3.8 DISINFECTION OF STEAM AND CONDENSATE

- A. Prior to connecting to existing piping, flush clean and disinfect new piping.
- B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. If final disinfectant residual tests less than 50 mg/l, repeat treatment.
- G. Flush disinfectant from system until residual disinfectant equals that of incoming water or

not more than 0.5 mg/l nor less than 0.2 mg/l.

- H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601.
- I. Bacteriological Analysis of Water: After the completion of disinfection procedure, including the final flushing as described heretofore, the Contractor shall obtain water samples from this system for bacteriological analysis. Requirements for satisfactory disinfection of water supply are that total plate count is less than 100 bacteria per cubic centimeter. Submit certified laboratory analysis to Guam EPA for evaluation.
- J. Final Approval: If bacteriological analysis does not satisfy above requirements, then disinfection procedure shall be repeated until these requirements are met.
- K. Discharging Used Water: Water used in the disinfection process must be disposed of to a ponding basin, percolation trench, holding tank, water truck tank or to any other location and method acceptable to Guam EPA.
- L. Certification: Deliver a "Certificate of Disinfection" to the GMHA Project Manager.

3.9 FIELD TESTS AND INSPECTIONS

- A. Field tests, and trial operations specified in this section shall be performed by the Contractor. The Contractor shall provide gas, oil, labor, equipment, and incidentals required for testing. The Contractor shall give the Contracting Officer 7 days' advance written notice of the dates and times scheduled for tests and trial operations.
- B. Field Inspections: Inspect piping system prior to initial operation, for conformance to drawings, specifications, and ASME B31.1. Equipment, material, or work rejected because of defects or non-conformance with drawings, specifications, and ASME B31.1 shall be replaced or corrected by the Contractor, as directed by the Contracting Officer.
- C. Field Tests: Conduct the following tests after completion of the piping installation and prior to initial operation.
- D. Piping System: Test piping system hydrostatically using water not exceeding 38 degrees C 100 degrees F. Conduct tests in accordance with the requirements of ASME B31.1 and as follows. Test the piping system after the lines have been cleaned as herein specified and before any insulation covering has been applied. Test piping system at 1 1/2 times the system pressure or 50 psig whichever is greater. Before performing tests, remove or valve off from the system, gages, traps, and other apparatus which may be damaged by the test pressure. Install a calibrated test pressure gage in the system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of joints and connections. Perform tests after installation and prior to acceptance.

3.10 INSTRUCTING AND DEMONSTRATION

- A. Upon completion of all required testing at a date set by the Architect to coincide with the Owner's acceptance of the completed Work, furnish all necessary personnel and thoroughly indoctrinate and instruct the Owner's maintenance and operation personnel in all aspects of operation and maintenance of the installed systems. Demonstrate the contents of the Operation and Maintenance Manual and ensure that the Owner's personnel are thoroughly familiar with all the aspects of operation and maintenance of

the installed systems.

- B. Train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions and provide electronic copy of video to Owner.

-- End of Section --

SECTION 15550

PACKAGED DAY TANK AND CHIMNEY

PART 1 - GENERAL

1.1 SCOPE

- A. This Section includes the standby generator fuel oil; engine exhaust and radiator exhaust systems.

1.2 QUALITY ASSURANCE

- A. Use sufficient journeyman and competent supervisors in execution of this portion of the work to ensure proper and adequate installation throughout. In the acceptance or rejection of installed work, no allowance will be made for lack of skill on the part of workmen.

1.3 SUBMITTALS

- A. General: Comply with the provisions of Section 15000.
- B. Product Data: Within 35 calendar days after award of contract, submit:
- C. Catalog cuts and other data required to demonstrate compliance with the specified requirements for the following:
 - 1. Pipes and Fittings
 - 2. Valves, Unions, Strainers
 - 3. Packaged Day Tank
 - 3. Chimney

PART 2 - PRODUCTS

2.1 FUEL OIL PIPING

- A. Pipes and Fittings: Fuel oil supply, return, vent, fill and gauge piping shall be Schedule 40 black steel with grey cast iron screwed fitting.
- B. Gate Valves: Gate valves shall be bronze, solid wedge, inside screw, traveling stem, screw-in bonnet, 200 lbs. W.O.G., screwed ends.
- C. Unions: Unions shall be bronze, threaded.
- D. Strainers: Single basket type, cast steel body, mesh 300 series stainless-steel baskets. Open area of basket shall be 2-1/2 time's inlet or outlet piping area.

- E. **Packaged Day Tank System:** U.L. Listed, all welded steel construction with overflow basin, 100 gallons capacity, "Simplex" SST Series or approved equal, complete with the following:
1. Duplex pump system, 7 Gpm capacity each pump.
 2. Auxiliary hand pump, piston type, 20 gallons per 800 strokes, self-primers to 20 feet lift, with hand pump check valve and hand valve, 1" NPT.
 3. 2" Lockable manual fill cap.
 4. Fuel strainer for 7 to 25 Gpm pumps.
 5. Vent cap (field installed) for outdoor vent, screened.
 6. Emergency vent, for pressure relief.
 7. Solenoid valve on pump intake to prevent loss of pump prime or tank flooding, ¾" NPT.
 8. ¾" Manual shut-off ball valve.
 9. Float switch in basin to sense day tank rupture, to close 3A contact for remote alarm and stop day tank pumps.
 10. Removable screen for top of overflow basin to prevent intrusion of debris.
 11. Fuel oil coolers, installed on return line, with electric fan and flow switch, installed and wired on day tank.
 12. Power available green pilot light.
 13. High fuel level emergency pump-stop switch with local alarm.
 14. Alarm horn installed on day tank.
 15. Multifunction duplex pump controller system providing selectable operating modes.

2.2 BOILER EXHAUST

- A. The chimney and flue must meet UL section 22A for positive pressure exhaust systems up to 6" water column and carry appropriate approval labels. The chimney shall be listed by UL as a " B.H.A" (Building heating appliance) chimney for continuous operation up to 1000 °F (540 °C) maximum. For application above 1000 °F (540 °C), the chimney shall be listed by UL as a "1400 °F chimney" for continuous operation up to 1400 °F (760 °C) maximum.
- B. The chimney and flue components must be of double wall construction and properly designed for positive pressure exhaust. The inner wall must be of 20 gauge (18 gauge 42" to 48" diameter) 304 stainless steel, with continuous laser welding. The outer wall must be of 24 gauge (20 gauge - 42" to 48" diameter) 304 stainless steel. A high temperature insulation must be installed between walls. The jointing must be using an assembly band, a finishing band and appropriate sealing material, as supplied by the manufacturer.
- C. All components must be installed according to the manufacturer recommendations and must meet the NFPA and local safety code requireme

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuel oil system in accordance with NFPA Standard 30.
- B. Install engine exhaust and piping system in accordance with the manufacturer's published instruction and recommendations.
- C. Fuel oil lines shall be tested and proven tight at 50 psig. In addition, fuel oil suction line shall be vacuum tested and proven tight at 20" HG.

--END OF SECTION --

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

This Section supplements all sections of Division 16, and shall apply to all phases of work specified, shown on the drawings, and required to provide all electrical systems complete and operable for the project. The work required under the Division is not limited to the work shown on the electrical drawings. Refer to site, architectural, structural and mechanical drawings, coordinate all such work to attain fully operational systems throughout the project. The intent of this specification is to provide a complete and operating electrical system in accordance with all Contract Documents.

1.02. WORK INCLUDED

Provide all labor, materials, services and skilled supervision necessary for the construction, erection, installation, connection, testing, and adjustment of all circuits and electrical equipment required by the Contract Documents, complete in all respects and ready for use.

1.03. SUPERVISION OF WORK

- A. Electrical work shall be under the full supervision of a professional electrical engineer or a master electrician registered to practice in Guam. Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit a certification from the Professional Engineer or master electrician stating that the work will be done under his full supervision. At the conclusion of the work, prior to final inspection, submit certification that the work was done in accordance with electrical construction documents and the installation complies with the latest edition of the National Electrical Code.
- B. Fire alarm system manufacturer's Technical Representative shall supervise, approve and certify installation and testing of Fire Alarm System devices and wiring.

1.04. COORDINATION OF WORK

- A. Plan all work so that it proceeds with a minimum of interference with other trades. Coordinate all openings required for equipment and conduit required for work of other trades. Provide all special frames, sleeves and anchor bolts as required. Coordinate electrical work with the mechanical installation.
- B. Work lines and established heights shall be in accordance with architectural drawings. Verify all dimensions shown and establish all elevations and detailed dimensions not shown.
- C. Lay out and coordinate all work well in advance to avoid conflicts or interference with other work in progress so that in the event of interference, the electrical layout may be altered to suit the conditions, prior to the installation of any work, and without additional cost to the Owner. Conflicts arising from lack of coordination shall be the contractor's responsibility.
- D. Maintain all code required clearance around electrical equipment. Unless specifically noted otherwise, establish the exact location of electrical equipment based on the actual dimensions of equipment furnished.

1.05. COOPERATION WITH OTHER TRADES

- A. Cooperate and coordinate all work of Division 16 with that of other trades; afford reasonable opportunity for the execution of their work. Properly connect and coordinate this work with the work of other trades at such time and in such a manner as not to delay or interfere with their work.
- B. Examine the drawings and specifications for the general and mechanical work and the work of other trades. Coordinate this work accordingly.
- C. Promptly report to the Contracting Officer any delay or difficulties encountered in the installation of this work which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to report shall constitute an acceptance of the work of other trades as being fit and proper for the execution of this work.

1.06. CODES, PERMITS AND FEES

- A. Perform work in accordance with the National Electrical Code, applicable building ordinances, and other applicable codes, hereinafter referred to as the "Code". Where the Contract Documents exceed minimum requirements, the most stringent shall apply unless variance is approved.
- B. Comply with all requirements for permits, licenses, fees, and codes. Obtain all required permits, licenses, inspections, and pay all fees required to perform the work described in the Contract Documents.
- C. Comply with all requirements of the applicable utility authorities serving the project. Make all arrangements with the utility authorities for proper coordination of the work.

1.07. MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.08. CONTRACT DRAWINGS

The Contract Drawings are shown in part diagrammatic, and intend to convey the scope of work, indicating the intended general arrangement of equipment, conduit and outlets. Follow the drawings in laying out the work and verify spaces for the installation of materials and equipment based on actual dimensions of equipment furnished. Wherever a question exists regarding the intended location of outlets or equipment, circuiting, etc., obtain instructions from the Contracting Officer before proceeding with the work.

1.09. EQUIPMENT OR FIXTURES

Equipment or fixtures shall be connected to provide circuit continuity in accordance with applicable codes whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures, and the point of circuit origin.

1.10. NEW EQUIPMENT AND MATERIAL

- A. Unless otherwise specified, equipment and materials of the same type of classification, and used for the same purpose shall be products of the same manufacturer. Use only new and unweathered material.

- B. Furnish products listed and classified by Underwriter's Laboratories, Inc.

1.11. APPLICABLE DOCUMENTS

- A. Design, manufacture, testing and method of installation of all apparatus and materials furnished under Division 16 of the specifications shall conform to the latest publications or standard rules of the following:

Institute of Electrical and Electronic Engineers
(Formerly American Institute of Electrical Engineers) - IEEE
National Electrical Manufacturers' Association - NEMA
Underwriters' Laboratories, Inc. - UL
National Fire Protection Association - NFPA
American Society for Testing and Materials - ASTM
American National Standards Institute - ANSI
National Electrical Code - NEC
National Electrical Safety Code - NESC
Uniform Fire Code - UFC
Uniform Building Code - UBC
Insulated Power Cable Engineers Association - IPCEA
American with Disability Act - ADA
American Institute of Steel Construction - AISC
Department of Public Works Standards, Government of Guam - DPW
Guam Fire Department Standards, Government of Guam - GFD
Guam Power Authority Standards, Government of Guam - GPA
Guam Telephone Authority Standards, Government of Guam - GTA

1.12. EXECUTION OF THE WORK

- A. Install equipment and materials in neat and workmanlike manner and align, level and adjust for proper operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.
- B. Where damage, marring or disfigurement has occurred, replace or refinish the damaged surfaces as directed, and to the satisfaction of the Contracting Officer.
- C. Provide the design, fabrication, and erection of all supplementary structural framing required for attachment of hangers or other devices supporting electrical equipment. Submit design/shop drawing to the Contracting Officer for approval.
- D. Outlet Location:
 - 1. Position of outlets: Center all outlets with regard to panelling, furring and trim. Symmetrically arrange outlets in the room. Satisfactorily correct outlets improperly located or installed. Repair or replace damaged finishes. Set outlets plumb and extend to the finished surface of the wall, ceiling or floor without projecting beyond same.

1.13. SPECIAL CONSIDERATION

- A. Cutting, Patching and Piercing: Obtain written permission from the Contracting Officer before cutting or piercing structural members.

1. Use craftsmen skilled in their respective trades for cutting, fitting, repairing, patching of plaster and finishing of materials including carpentry work, metal work or concrete work required for by Division 16. Do not weaken walls, partitions or floor by cutting. Holes required to be cut in floors must be drilled or cored without breaking or spalling around the holes. Do all necessary patching and/or refinishing as instructed by the Contracting Officer.
 2. Sleeves through floors and walls to be galvanized rigid steel flush with walls, ceiling or finished floors; size to accommodate the raceway.
 3. Use care in piercing waterproofing. After the part piercing waterproofing has been set in place, seal opening and make absolutely watertight.
 4. Provide baked white enamel painted spring-clipped escutcheon plates where exposed pipe passes through walls, floors, or ceilings. Cover sleeves and entire opening made for the pipe with escutcheon plates. Field applied paint finish shall match color of surrounding finish. Seal all conduit openings through floor slabs, masonry walls, and continuous partitions to make air and watertight. Tightly caulk space between conduit and abutting materials with fiberglass insulation and nonflammable sealant.
 5. All through wall, floor, or ceiling penetrations must be properly sealed with UL Listed fire-stopping material.
- B. Seal equipment or components exposed to the weather and make watertight and insect-proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.
- C. Equipment Identification: Identify each piece of equipment including disconnect switches and motor starters, with plastic laminate nameplates, black face with white core letters, having proper and complete identification. Clearly identify on the equipment served, and spell out the full name of the equipment, such as "Air Handling Unit AHU-1" and "Hot Water Cir. Pump P-1". Do not use abbreviated plan references such as "AHU-1" or "P-1".
- D. Equipment Access: Locate starters, switches, receptacles, and pull boxes to allow easy access for operation, repair and maintenance, and if concealed, provide access doors.
- E. Equipment Bases: Provide equipment bases on all floor-mounted equipment furnished under this Contract.
- F. Protection of apparatus, materials and equipment: Take all necessary precautions to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. The Contracting Officer may reject any particular piece or pieces of material, apparatus, or equipment which has scratches, dents or otherwise damaged.
- G. Operation and Maintenance Manuals: During the time of the Contract and before final acceptance of the electrical installation, submit to the Contracting Officer three copies of all descriptive literature, maintenance recommendations from the equipment manufacturer, data of initial operation, wiring diagrams and parts list of each item of electrical equipment installed under the Contract; submit all manufacturer's guarantees and warranties.
1. Refer to Division 1 for additional requirements.

- H. **Painting Preparation:** Prepare all exposed fittings, boxes, supports and panelboards for painting; remove traces of oil, grease and dirt. Employ all necessary precautionary methods to prevent scratching or defacing of all electrical apparatus and devices.
- I. **Painting:** Exposed conduit, boxes installed after room has been painted, shall be painted to match room finish by this contractor.
 - 1. **Corrosion Control:** All corrosive metal surfaces, conduits/fittings, pipelines and structures shall be provided with corrosion inhibiting primer before installation. Appropriate surface preparation shall be made before application of primer.
- J. **Rust Prevention:** Provide hot dip galvanized finish for all ferrous materials. In addition, outdoor installations shall be field painted with two coats of epoxy paint.
- K. **Tests:** Provide all tests as outlined hereinafter, and other tests necessary to establish the adequacy, quality, safety, completed status, and suitable operation of each system. Tests shall be conducted in the presence of the Contracting Officer.
 - 1. **Insulation resistance of conductors.**
- L. **Seismic Consideration:** Installation shall meet Seismic requirements per IBC 2018.
- M. **Windload Consideration:** Installation exposed to outdoors shall be designed to withstand wind load requirements per IBC 2018.
- N. **Short Circuit Coordination Study:** Contractor shall retain the services of a Registered Electrical Engineer and perform Short Circuit Coordination Study for the whole Electrical Distribution System. Breaker settings shall be adjusted as recommended by the study.

1.14. QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Division in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.15. ELECTRICAL SERVICE

- A. Electrical service to the building is as indicated on the drawings.
- B. Make all necessary arrangements with the serving utilities, and pay all costs and fees, assessed to the project by the serving utilities. All work shall be in accordance with serving utilities standards and subject to their approval.

1.16. PRODUCT HANDLING

Comply with pertinent provisions of Division 1.

1.17. WARRANTY

Provide one year warranty on all labor and materials.

1.18. AS-BUILT DRAWINGS

- A. The Contractor shall maintain at the site one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders, and other modifications, in good order and marked to record all changes made during construction. These shall be made available to the Contracting Officer.
- B. At the conclusion of the work, the Contractor shall submit "As-Built" drawings, 2 sets in CD-Rom in PDF format and a copy of Mylar drawings. As a condition for acceptance of work, "as-built" reproduces shall be signed by Contractor attesting that all changes have been incorporated, dated and delivered to the Contracting Officer.

1.19. SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra Products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed; obtain receipt prior to final payment.

END OF SECTION

SECTION 16402
INTERIOR WIRING SYSTEMS

PART 1 - GENERAL

- 1.01. RELATED REQUIREMENTS: Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.
- 1.02. SUBMITTALS
- A. Manufacturer's Data:
- Circuit breakers
 - Disconnect Switches
 - Conduit and fittings (each type)
 - Insulated conductors
- B. Test Reports: Submit test results for approval in report form.
- 1. 600-volt wiring test.
 - 2. Operation Test
- 1.03. QUALITY ASSURANCE: In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning to mean Contracting Officer.

PART 2 - PRODUCTS

- 2.01. MATERIALS AND EQUIPMENT: Materials, equipment and devices shall, as a minimum, meet the requirements of UL, where UL standards are established for those items, and the requirements of NFPA 70.
- 2.02. CONDUIT AND FITTINGS
- A. Rigid Aluminum Conduit: ANSI C80.5, UL 6.
- B. Flexible Metal Conduit: UL 1.
- 1. Liquid-Tight Flexible Metal Conduit (Steel): UL 360.
- C. Fittings for Metal Conduit and Flexible Metal Conduit: UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.
- 1. Fittings for Rigid Metal Conduit and IMC: Threaded type. Split couplings unacceptable.

- 2.03. CABINETS, JUNCTION BOXES AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES): UL 50, hot-dip zinc-coated, if of sheet steel.
- 2.04. WIRES AND CABLES: Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be used.
- A. Conductors: No. 10 AWG and smaller shall be solid; No. 8 AWG and larger shall be stranded. Conductors shall be copper, unless indicated otherwise.
 - 1. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 Low-energy, remote-control and signal circuits, No. 16 AWG.
 - B. Color Coding: Provide for all service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors, and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the other neutral shall be white with a colored (not green) stripe. The color of the ungrounded conductors in different voltage systems shall be as follows:
 - 1. 120/208 volt, 3-phase: Phase A - black
Phase B - red
Phase C - blue
 - 2. 277/480 volt, 3-phase: Phase A - brown
Phase B -orange
Phase C -yellow
 - 3. 120/240 volt, single phase: red and black.
 - C. Insulation: Unless specified or indicated otherwise or required by NFPA 70, all power and lighting wires shall be 600-volt, Type THW, THWN, XHHW, or RHW, except that grounding wire may be Type TW; remote-control and signal circuits shall be Type TW, THW or TF. Conductors shall conform to UL 83. Where lighting fixtures require 90 degree C conductors, provide only conductors with 90 degree C insulation or better.
 - D. Bonding Conductors: ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.
- 2.05. SPLICES AND TERMINATION COMPONENTS: UL 486A for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

- 2.06. ENCLOSED CIRCUIT BREAKERS: UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.
- 2.07. FUSES: NEMA FU 1. Provide a complete set of fuses for each fusible switch as required. Time-current characteristics curves of fuses serving motors or other circuit protective devices shall be coordinated for proper operation. Fuses shall have a voltage rating not less than the circuit voltage.
 - A. Cartridge Fuses, Current-limiting Type (Class R): UL 198E, Class RK-1, RK-5 time-delay type. Associated fuseholders shall be Class R only.
- 2.08. GROUNDING AND BONDING EQUIPMENT: UL 467. Ground rods shall be copper-encased steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.
- 2.09. CONTACTOR: NEMA ICS 2, electrically operated, mechanically held contactor rated as indicated. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contactor with hand-off automatic selector switch.
- 2.10. NAMEPLATES: Fed. Spec. L-P-387. Provide as specified in Section 16050, "Basic Electrical Materials and Methods."
- 2.11. SOURCE QUALITY CONTROL: Test opening around electrical penetrations through fire resistive-rated walls, partitions, floor or ceiling for fire resistive integrity in accordance with ASTM E 814.

PART 3 - EXECUTION

- 3.01. INSTALLATION: Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.
 - A. Wiring Methods: Provide insulated conductors installed in conduit, except where specifically indicated or specified otherwise, or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in all feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire walls, fire partitions, or floors shall be metallic on both sides of fire walls, fire partitions, or floors for minimum distance of 6 inches.
 - 1. Aluminum Conduit: Use in exposed installation and in unairconditioned spaces.
 - a. Do not install underground or encase in concrete.
 - b. Do not use brass or bronze fittings.
 - 2. Nonmetallic Conduit:

- a. Underground Conduit: PVC, Type EPC-40; or fiberglass.
 - b. Conduit Embedded in Concrete: PVC, Type EPC-40.
 - c. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80:
 - (1) Do not use in areas subject to severe physical damage (including, but not limited to, mechanical equipment rooms, electrical equipment rooms, etc.).
 - (2) Do not use in hazardous areas.
 - (3) Do not use in penetrating fire-rated walls or partitions, fire rated floors, etc.
- B. Conduit Installation:** Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot-water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.
1. Where conduits rise through floor slabs, the curved portion of bends shall not be visible above the finish slab.
 2. **Conduit Support:** Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. The load applied to fasteners shall not exceed one-fourth of the proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4-inch in concrete joints shall not cut the main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet-metal screws. In suspended-ceiling construction, run conduit above the ceiling. Spring steel fasteners may be used for lighting branch circuit conduit supports in suspended ceiling in dry locations.
 3. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with a hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of all obstructions.
 4. Install pull wires in empty conduit in which wire is to be installed by others. The pull wire shall be plastic having minimum 200-pound tensile strength. Leave a minimum 12 inches of slack at each end of the pull wire.
 5. **Telephone Conduits:** Install in accordance with the specified requirements for conduit and with the additional requirement that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two

90-degree bends or the equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits one-inch trade size and larger shall be minimum five times the nominal diameter. Terminate conduit at bottom edge of backboard or in terminal cabinet with two locknuts and a plastic bushing.

6. **Conduit Installed in Concrete Floor Slabs:** Locate so as not to adversely affect the structural strength of the slabs. Install conduit within the middle one-third of the concrete slab. Do not stack conduits. Space conduit horizontally minimum three diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Increase slab thickness as necessary to provide a minimum one-inch cover over conduit. Where embedded conduits cross expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Conduit larger than one-inch trade size shall be parallel with or at right angles to the main reinforcement; when at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Where nonmetallic conduit is used, raceway must be converted to plastic coated rigid steel before rising above floor, unless specifically indicated otherwise.
 7. **Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into the wall of metal enclosures. Install bushings on the ends of conduits and provide insulating type where required by NFPA 70.**
 8. **Stub-Ups:** Provide conduits stubbed up through concrete floor for connection to free-standing equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above the floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.
 9. **Flexible Connections:** Provide flexible connections of short length, 6 feet maximum, for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.
- C. **Boxes, Outlets and Supports:** Provide boxes in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the cast-metal hub type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 7 feet above interior floors and walkways, or when installed in hazardous areas. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit; nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have the volume required by NFPA 70 for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall be minimum 4 inches square or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered tile-type, or standard boxes having square-cornered tile-type covers. Provide gaskets for cast-metal boxes installed in

wet locations and boxes installed flush with the outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by the fixture terminal operating temperature; fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of the ceiling supports or make adequate provisions for distributing the load over the ceiling support members. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type fastener maximum 24 inches from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.

1. Boxes for use with raceway systems shall be minimum 1-1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be minimum 4 inches square, except that 4 inch by 2 inch boxes may be used where only one raceway enters the outlet. Telephone outlets shall be a minimum of 4 inches square by 1-1/2 inches deep.
 2. Pull Boxes: Construct of at least the minimum size required by NFPA 70 of code-gage aluminum or galvanized sheet steel, compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Furnish boxes with screw-fastened covers. Where several feeders pass through a common pull box, tag the feeders to indicate clearly the electrical characteristics, circuit number, and panel designation.
 3. Extension Rings: Used only on existing boxes in concealed conduit systems where wall is furred out for new finish.
- D. Mounting Heights: Mount panelboards, circuit breakers, and disconnecting switches so the height of the operating handle at its highest position maximum 72 inches above the floor. Mount lighting switches receptacles and other devices as indicated. Measure mounting heights of wiring devices and outlets to the center of device or outlet.
- E. Conductor Identification: Provide conductor identification within each enclosure where a tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated self-sticking markers, colored nylon cable ties and plates, or heat-shrink type sleeves. Identify control circuit terminations.
- F. Splices: Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with an insulated pressure type connector. Make splices in conductors No. 8 AWG and larger diameter with a solderless connector and cover with an insulation material equivalent to the conductor insulation.
- G. Covers and Device Plates: Install with edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings are not permitted. Plates shall be installed with an alignment tolerance of 1/16 inch. The use of sectional type device plates are not permitted. Plates installed in wet locations shall be gasketed.

- H. **Electrical Penetrations:** Openings around electrical penetrations through fire resistance rated walls, partitions, floors, or ceilings shall be sealed to maintain fire resistive integrity as tested per ASTM E 814.

- I. **Grounding and Bonding:** In accordance with NFPA 70. Ground all exposed non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at the main service equipment and extend grounding conductor to the point of entrance of the metallic water service. Make ground connection to driven ground rods on the exterior of the building. Where ground fault protection is employed, ensure that the connection of ground and neutral does not interfere with the correct operation of the fault protection. Bond building foundation rebars to ground.
 - 1. **Grounding Conductor:** Provide an insulated, green equipment grounding conductor in all feeder and branch circuits including lighting circuits. Grounding conductor shall be separated from the electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways.
 - 2. **Resistance:** The maximum resistance to ground of the grounding system shall not exceed 25 ohms under normally dry conditions. Where the resistance obtained exceed 25 ohms provide additional ground rods to achieve the resistance level. Spacing of ground rods shall not exceed 10 feet apart.

- J. **Repair of Existing Work, Demolition, and Modification of Existing Electrical Distribution Systems:**
 - 1. Lay out the work carefully in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work. Repair any damage to buildings, piping, and equipment using skilled craftsmen of the trades involved.
 - 2. Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.
 - a. Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, fittings, etc., back to equipment's source.
 - b. Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

- K. **Motor Load:** When motor size provided differs from the size indicated or specified, make adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate the equipment actually provided.

- 3.02. **FIELD QUALITY CONTROL:** Furnish test equipment and personnel and submit written copies of test results to the Contracting Officer. Give five working days notice prior to each test.
- A. **Devices Subject to Manual Operation:** Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.
 - B. **Test on 600-Volt Wiring:** Test all 600-volt wiring to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on all wiring No. 6 AWG and larger diameter using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance; minimum resistance shall be 250,000 ohms.

END OF SECTION