BOILERPLATE TABLE OF CONTENTS

SECTION 011000 - SUMMARY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: Lewis & Clark Caverns, State Park Concessions Upgrade

1. Cardwell, MT: FWP # 7186601

B. Owner: State of Montana.

1. Owner's Representative: Paul Valle, Design and Construction Phase P.O. Box 200701, Helena, MT 59620-0701. Phone: 406-841-4013

C. Agency: Montana Fish, Wildlife & Parks.

1. Agency Representative: Paul Valle, Design and Construction Phase P.O. Box 200701, Helena, MT 59620-0701. Phone: 406-841-4013

D. Architect: Faure Halvorsen Architects, PC.

1. Architect Representative: Matthew Faure, 1425 West Main Street, Bozeman, MT 59715 Phone: 406-587-1204.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Renovations of existing Lewis & Clark Caverns Snack Bar and Kitchen

B. Type of Contract.

1. Project will be constructed under a single contract.

1.4 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operation as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to areas outlined in the drawings and specifications.

2. Driveways, Walkways and Entrances: Keep driveways and entrances serving existing premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.5 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy existing buildings and portions of the site during the entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations.

    1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
    2. Notify Owner not less than 48 hours in advance of activities that will affect Owner's operations.

1.6 WORK RESTRICTIONS

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

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

B. On-Site Work Hours: Limit work hours to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless alternate work hours are approved by the Owner.

C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

    1. Notify Architect 48 hours in advance of proposed disruptive operations.

D. Nonsmoking Building: Smoking is not permitted within existing buildings, new construction, or within 25 feet of entrances, operable windows, or outdoor-air intakes.

E. Controlled Substances: Use of tobacco products and other controlled substances within the existing building is not permitted.

SECTION 012500 - SUBSTITUTION PROCEDURES PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

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

1. Substitution Request Form: Use AIA Request Form, or similar document.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    d. Samples, where applicable or requested.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within
7 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

    a. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

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

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

    a. Requested substitution is consistent with the Contract Documents and will produce

indicated results.

b. Requested substitution will not adversely affect Contractor's construction schedule.
c. Requested substitution has received necessary approvals of authorities having jurisdiction.
d. Requested substitution is compatible with other portions of the Work.
e. Requested substitution has been coordinated with other portions of the Work.
f. Requested substitution provides specified warranty.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 15 days after commencement of the Work.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

END OF SECTION 012500

SECTION 012900 - PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with continuation sheets.
    b. Submittal schedule.

2. Submit the schedule of values to Architect at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use format provided in specification manual. Provide at least one line item for each major portion of the work.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Name of Architect.
    c. State of Montana project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Arrange schedule of values consistent with standard format of AIA Document G703 and the manual.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

6. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

7. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.

D. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt. One copy shall include waivers of lien and similar attachments as required by contract.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule.
4. Submittal schedule.
5. List of Contractor's principal consultants.
6. Copies of building permits.

F. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

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

1. Evidence of completion of Project closeout requirements.
2. Updated final statement, accounting for final changes to the Contract Sum.
3. Contractor's Affidavit of Completion.
4. Consent of Surety to Final Payment.

END OF SECTION 012900

5. Contractor's Affidavit of Completion.
6. Consent of Surety to Final Payment.

END OF SECTION 012900

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

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

1.3 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

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

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

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

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

1. Initial Review: Allow seven (7) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.

D. Resubmittal Review: Allow seven (7) days for review of each resubmittal Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.

e. Name of supplier.
f. Name of manufacturer.
g. Other necessary identification.

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

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

a. File name shall use project identifier.

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use electronic forms acceptable to Owner**,** containing the following information:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Contractor.
e. Names of subcontractor, manufacturer, and supplier.

F. Options: Identify options requiring selection by Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

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

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

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

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

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

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

2. Action Submittals: Submit five paper copies of each submittal unless otherwise indicated. Architect will return three copies.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Application of testing agency labels and seals.
    f. Notation of coordination requirements.
    g. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. PDF electronic file.
    b. Three paper copies of Product Data unless otherwise indicated. Architect will return one copy

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

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

    a. Identification of products.
    b. Compliance with specified standards.
    c. Notation of coordination requirements.
    d. Notation of dimensions established by field measurement.
    e. Relationship and attachment to adjoining construction clearly indicated.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.
    b. Three copies of each submittal. Architect will retain two copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
    a. Generic description of Sample.
    b. Product name and name of manufacturer.

3. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
      1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

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

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

D. Incomplete submittals will be considered nonresponsive and will be returned for resubmittal without review.

END OF SECTION 013300

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated.

B. Water: Water from Owner's existing water system may available for use without metering and without payment of use charges. Contractor shall provide all connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Contractor shall provide all connections and extensions of services as required for construction operations.

1.3 QUALITY ASSURANCE

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

B. Accessible Temporary Egress: Comply with applicable provisions in 2009 IBC.

1.4 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 EQUIPMENT

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

3.2 TEMPORARY UTILITY INSTALLATION

A. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use. Water service may require well installation and utility work before it is available.

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

C. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

E. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

F. Parking: Use designated areas of Owner's site for parking areas for construction personnel.

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

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

D. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating is needed and permanent enclosure is not complete, insulate temporary enclosures.

F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.4 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Discard or replace water-damaged and wet material.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.5 OPERATION, TERMINATION, AND REMOVAL

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

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

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

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

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

1. Materials and facilities that constitute temporary facilities are property of Contractor.

END OF SECTION 015000

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

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

1.2 ACTION SUBMITTALS

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

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

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 SUBSTANTIAL COMPLETION PROCEDURES

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

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 7days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect**.** Label with manufacturer's name and model number where applicable.

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

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

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 7 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

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

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 7days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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

2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:

a. MS Excel electronic file. Architect will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

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

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

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

PART 2 - EXECUTION

2.1 FINAL CLEANING

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

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

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

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment and other similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

2.2 REPAIR OF THE WORK

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

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

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

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

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

END OF SECTION 017700

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.3 QUALITY ASSURANCE

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

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 7.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

C. Concrete Testing Service: Owner may engage a qualified independent testing agency to perform material evaluation tests.

D. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

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

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II gray.

B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm] nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, 1-inch (25-mm) nominal maximum aggregate size.

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

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

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

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder: Sheet type vapor retarder, ASTM 1745, not less than 10 mils thick.

1. Stego, Class C, (10 mils), or approved equal.
2. Seam tape as recommended by manufacturer.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.7 CONCRETE MIXTURES

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, according to ACI 301.

B. Admixtures: Use admixtures according to manufacturer's written instructions.

C. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (31 MPa > at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).

2.8 FABRICATING REINFORCEMENT

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

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M[and ASTM C 1116/C 1116M] and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Do not chamfer exterior corners and edges of permanently exposed concrete.

3.2 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. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

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

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints at a depth of 1-1/2 inches.

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

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

3.8 FINISHING FLOORS AND SLABS

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

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

1. Apply a trowel finish to all interior concrete slabs.

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

C. Broom Finish: Apply a broom finish to exterior concrete slabs.

1. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot- weather protection during curing.

B. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.

3.10 CONCRETE SURFACE REPAIRS

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

3.11 FIELD QUALITY CONTROL

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

END OF SECTION 033000

SECTION 061000 - ROUGH CARPENTRY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Wood blocking, cants, and nailers.
5. Wood furring and grounds.
6. Wood sleepers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Montana Wood Products: The contractor is encouraged to use Montana produced dimensional lumber and wood products where feasible and cost effective.

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all rough carpentry as follows:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Framing Material: All framing materials No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Douglas fir-larch; WCLIB or WWPA.
c. Spruce-pine-fir; NLGA.
d. Douglas fir-larch (north); NLGA.

B. Framing: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa) and an extreme fiber stress in bending of at least 1000 psi (6.9 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

1. Application: Framing other than interior partitions.

2.4 ENGINEERED WOOD PRODUCTS

A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.

B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

1. Extreme Fiber Stress in Bending, Edgewise2600 psi (17.9 MPa) for 12-inch nominal- (286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 1,800,000 psi (12 400 MPa).

2.5 SHEAR WALL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Shear Transfer Systems.
2. Simpson Strong-Tie Co., Inc.
3. Weyerhaeuser Company.

C. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.

1. Products shall contain no urea formaldehyde.

D. Steel-Framed Shear Wall Panels: Prefabricated assembly consisting of cold-formed galvanized steel panel, steel top and bottom plates, and wood studs.

E. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of species specified..

C. For concealed boards, provide lumber with 15 percent maximum moisture content and the following species and grades:

1. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: NES NER-272.

C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.9 METAL FRAMING ANCHORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations.

D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high- strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.

F. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

G. Do not splice structural members between supports unless otherwise indicated.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

3.2 PROTECTION

A. Protect rough carpentry from weather.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Plywood: DOC PS 1 unless otherwise indicated.

C. Oriented Strand Board: DOC PS 2.

2.2 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

2.3 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.

B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.5 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
   3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two- Family Dwellings."

D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

   1. Wall and Roof Sheathing:
      a. Nail to wood framing.
      b. Screw to cold-formed metal framing.
      c. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION 061600

SECTION 072100 - THERMAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Spray polyurethane foam insulation.
2. Rigid Polystyrene Board Insulation
3. Fiberglass batt insualation.
4. Loose fill insulation.
5. Vinyl vapor barrier.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

A. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Corporation.
2. Johns Manville.
3. Owens Corning.
4. Approved Equal.

2.2 VAPOR RETARDERS

A. Vapor Retarders: 10 mil high performance polyethylene vapor retarder, installed on the ceiling. (Interior, warm side of blown in insulation assemblies.) Comply with ASTM D 4397, with maximum permeance rating of 0.13 perm

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.3 RIGID BOARD INSULATION

A. Rigid Polystyrene Board Insulation: Dow SM Polystyrene, or approved equal.

1. R-10 minimum.

2. Installation per manufactures recommendation below grade and under slabs.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Install vapor retarder in large sheets. Lap and seal joints and penetrations per manufacturers recommendations.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION 072100

SECTION 075416 – ETHYLENE INTERPOLYMER (KEE) ROOFING

PART 1 - GENERAL

1.0 SCOPE OF WORK

A. Contractor shall submit proposal to provide all labor, material, equipment, and tools as required work in this section and related sections.

B. Contractor shall remove and dispose of all existing roofing systems and sheet metal flashings down to the concrete and wood decks.

C. Contractor shall provide new EPS insulation per drawings and ½" 4'x4' Dens Deck Prime fire barrier / Cover board over insulation. Contractor is to attach roof insulation and Dens Deck Prime using Insulation adhesive on concrete deck areas. Contractor is to mechanically attach insulation with dens deck layer of ½" 4'x8' Dens Deck prime on wood deck area.

D. Contractor shall provide new Fully Adhered roof membrane system and flashings in accordance with manufacturer requirements and as per specified in the section. Note; it is the contractor's responsibility to verify all the job site conditions, including but not limited to roof measurements, roof access, core cuts, etc. The owner will not pay for any extra work if the contractor failed to ascertain or verify the job condition prior to submitting a bid. It will be the contractor's responsibility to comply with all manufacturer requirements. (i.e. minimum flashing heights)
The contractor shall include in their bid any modification required by the manufacturer of the membrane in order to provide the owner with the 20-year Labor/ Material warranty as per this specification.

E. Contractor shall provide new galvanized or painted sheet metal copings, counter flashings, and drip edge as indicated in the drawings. All sheet metal flashing shall be a minimum of 24 gauge and have a 20-year finish warranty.

F. At all drain locations; the contractor shall test drains and associated piping prior to starting roofing operations. If the drains and piping are not functioning properly, the contractor is to notify the owners' representative. The owner cannot assume any financial responsibility for drain and associated pipe repairs if this procedure is not followed prior to starting roofing operations. At the completion of the roofing, all drains and associated piping are to be functioning properly.

G. Contractor shall obtain and pay for the necessary building permit as required by state and local building agencies.

1.01SUMMARY

A. Fully adhered thermoplastic roofing membrane system on <u>all</u> roof areas.
B. Flashings.
C. Stack boots, roofing expansion joints, counter flashings and walkway pads.

1.02 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
C. Roofing System Design: Provide membrane-roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

1.03 SUBMITTALS

A. Product Data: Provide data indicating membrane materials, flashing materials, insulation, surfacing, adhesives and fasteners.
B. Specimen Warranty: For approval.
C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials.
D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing systems.
E. Manufacturer's Installation Instructions; Indicate membrane seaming precautions and perimeter conditions requiring special attention.
F. Manufacture's Certificate: Certify that products meet or exceed specified requirements. Signed by roofing manufacturer certifying that roofing systems complies with requirements specified and meets requirements for roof system warranty.
G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum (10) years of documented experience. The roofing membrane and system shall be identical to that used for this project and which can show evidence of these materials being satisfactorily used on at least ten (10) projects of similar size, scope an type within such a period. Obtain components for membrane roofing system from or approved by roofing membrane manufacturer.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience installing membrane systems that is approved. Company must be an approved installer of the membrane system and eligible to receive manufacturer's warranty.
C. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristic indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
    1. Exterior Fire-Test Exposure: Class A; for application and roof slopes indicated.

1.05 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section.
B. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
B. Store products in weather protected environment, clear of ground and moisture.
C. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by the manufacturer. Protect stored liquid materials from direct sunlight.
    1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
D. Protect foam insulation from direct exposure to sunlight.
E. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.07 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.08 WARRANTY

A. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace components of membrane roofing system that fail in materials or workmanship within the specified warranty period. Failure includes roof leaks.
    1. Warranty Term: 20 years from date of substantial completion.
    2. Special Warranty includes roofing membrane, base flashings, roofing membrane accessories, fasteners, walkway products and other components of membrane roofing system.
    3. For repair and replacement include costs of both material and labor in warranty.
    4. Warranty shall include 1 ½" hail warranty and shall not include exclusions for ponding water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
    1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
    2. Products: Subject to compliance with requirements, provide one of the products specified.
    3. Available Manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the manufacturers specified.

2.02 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Manufacturers and Products

1. EPDM Roofing: Firestone, or equal.
   a) Thickness: 60 mils (1.1 mm), nominal.
   b) Color: Black.
2. Material: ASTM 6754-002 “Keytone Ethylene Ester (KEE) Sheet Roofing Substitution request must comply with the following Minimum Physical Properties

PROPERTY	TEST METHOD	RESULT
Thickness	ASTM D-751	50 mil XT Tensile
Strength	ASTM D-882	9500 psi
Puncture Resistance	ASTM D-751 Fed Std 101B Method 2031	23 joules

3. Polymer base to consist of 50% Elvaloy to maintain a pliable sheet over warranty period.
4. Seaming Materials: As recommended by membrane manufacturer.
5. Flexible Flashing Material: Same material as membrane.

2.03 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
B. Cover board Joint Tape: Glass fiber reinforced type as recommended by manufacturer, compatible with roofing materials; 6 inches wide; self-adhering.
C. Insulation Adhesive: As recommended by insulation manufacturer.
D. Metal Termination Bars: Manufacturer’s standard predrilled aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.
E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening cover board to wood substrate, and acceptable to membrane roofing system manufacturer.
F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, surface mounted counter flashing, cover strips, and other accessories.
G. Gypsum Roof Barrier Board: ASTM C 1177, glass-mat, water resistant gypsum substrate, ½” thick primed dens deck. Note: In all areas where using insulation adhesive, the contractor must use 4’ x 4’ maximum sized board. All seams must be taped prior to fully adhering the roofing membrane.
H. Walkway pads: Type as recommended by membrane manufacturer; size as indicated.

2.04 INSULATION

A. Molded Polystyrene Board Insulation: Expanded polystyrene board, ASTM C 578; with drainage channels one face, with the following characteristics:
   1. Board Size: 48 x 48 inch.
   2. Tapered Board: Slope as indicated per drawings. Fabricate of fewest layers possible.
   3. Average R-value of any tapered roof area shall not be less than R-30. Minimum R-value of any sloped roof area shall not be less than R-30. Notify architect immediately if conflicts arise.

4. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.05 COVERBOARD

A. Cover board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Georgia-Pacific Corporation, " ½" 4'x4' Dens Deck Primed"
         i. Concrete deck areas
      b. Georgia-Pacific Corporation, " ½" 4'x8' Dens Deck primed"
         i. Wood deck areas mechanically attached

B. Cover board Accessories
   1. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead applied; low-rise, two-component urethane adhesive formulated to attach cover board to underlying roof insulation layer.
   2. Glass fiber reinforced type as recommended by manufacturer, compatible with roofing materials; 6 inches wide; self-adhering.

2.06 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16-inch-thick, and acceptable to membrane roofing system manufacturer. Walkways shall be included in the manufacturer's warranty of the entire period of the warranty.

   a. X-TRED Walk Pads as indicated in drawing.

PART 3 EXECUTION

3.01 INSTALLATION-GENERAL

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater that can be weatherproofed the same day.

3.02 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set.

3.03 WOOD DECK PREPARATION

A. Verify flatness and tightness of joints of wood decking: Fill knot holes with latex filler.

3.04 CONCRETE DECK PREPARATION

A. Fill surface honeycomb and variations with latex filler.

3.05 INSULATION – UNDER MEMBRANE

A. Attachment of Insulation: Embed insulation in adhesive in full contact, in accordance with roofing and insulation manufacturers' instructions
B. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
C. Do not apply more insulation than can be covered with membrane in same day.

3.06 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
    1. Install sheet according to ASTM D 5082.
    2. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
    3. Adhesively attach roofing membrane to primed roof board and secure at terminations, penetrations, and perimeter of roofing.
    4. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
    5. Seams: Clean seam areas, overlap roofing membrane and hot-air-weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
        a. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
        b. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
        c. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
    6. At intersections with vertical surfaces:
        a. Extend membrane a minimum of 4 inches onto vertical surfaces.
        b. Fully adhere flexible flashing over membrane and up to nailing strips.
        c. Around roof penetrations, seal flanges and flashings with flexible flashing.
        d. Coordinate installation of retrofit roof drains and sumps and related flashings.
        e. Overflow scuppers must be fabricated as indicated on drawings per manufacturers details.

3.07 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
D. Clean seam areas and overlap, firmly roll sheet into the adhesive. Weld side and end laps to ensure a watertight seam installation.
E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.08 FIELD QUALITY CONTROL

A. In-Progress Inspection: Contractor shall include in their bid, the cost for roofing system manufacturer's Representative to inspect roofing installation prior to the contractor's completion of 50% of the project. Notify Owner's representative 48 hours in advance of date and time of inspection.
B. Final Roof Inspection: Contractor shall include in their bid, the cost for the roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit final inspection report to the owner's representative
C. Notify Owner's representative 48 hours in advance of date and time of inspection.
D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with the specified requirements.

3.09 PROTECTING AND CLEANING

A. Correct deficiencies in or remove membrane-roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane- roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
B. Clean over spray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 0754168

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 – GENERAL

1.0 SUMMARY

A. Section Includes:

1. Manufactured counterflashing.
2. Formed roof drainage sheet metal fabrications.

1.1 SUBMITTALS

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

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field- assembled work.

1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

C. Samples: For each exposed product and for each finish specified.

D. Maintenance data.

E. Warranty: Sample of special warranty.

1.2 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

B. Preinstallation Conference: Conduct conference at Project site.

1.3 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2. Color: As selected by Architect from manufacturer's full range.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.

C. Solder:

1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 REGLETS

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch-(100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Galvanized Steel

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 12 feet with no joints allowed within 24 inches (600 mm) of corner or intersection. Where

lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches (32 mm) for nails, not less than 3/4 inch (19 mm) for wood screws, and metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.

3.2 ROOF DRAINAGE SYSTEM INSTALLATION

A. Parapet Scuppers: Install scuppers in existing scupper locations. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with approved sealant and clamp flashing to pipes that penetrate roof.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section.

1. Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
2. Interior joints in vertical surfaces and horizontal non-traffic surfaces.

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water- resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Compatibility and adhesion test reports.

1.4 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Final Acceptance.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Single-Component Neutral-Curing Silicone Sealant JS-#1:

1. Available Products:
   a. Dow Corning Corporation; 795.
   b. Approved Equal.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.

D. Single-Component Neutral-Curing Silicone Sealant JS-#2:

1. Available Products:
   a. Dow Corning Corporation; Trademate Paintable.
   b. Approved Equal.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.

E. Single-Component Neutral-Curing Silicone Sealant JS-#3:

1. Available Products:
   a. Dow Corning Corporation; 888.
   b. Approved Equal.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type O (open-cell material) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.

    a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

    b. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates**,** where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

D. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

E. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-#1: Exterior perimeter joints between finish materials and frames of doors, windows, vents, and louvers.

1. Joint Sealant: Single-component neutral- and basic-curing silicone sealant JS-#1.
2. Joint-Sealant Color: As selected from manufacturer’s standard colors.

B. Joint-Sealant Application JS-#2: Perimeter joints between interior wall surfaces and frames of interior doors and windows.

1. Joint Sealant: Single component neutral- and basic-curing silicone sealant JS- #2.
2. Joint-Sealant Color: As selected from manufacturer’s standard colors, and paintable to match adjacent surfaces.

C. Joint-Sealant Application JS-#3: Control joints in interior concrete slabs.

1. Joint Sealant: Single component neutral- and basic-curing silicone sealant JS- #3.
2. Joint-Sealant Color: Gray to match concrete color.

END OF SECTION 079200

SECTION 08111 – HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes hollow metal doors and frames.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.

B. Shop Drawings: Provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings.

C. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ceco Door Products.
2. CURRIES Company.
3. Approved equal.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 zinc-iron-alloy (galvannealed) coating designation.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.

G. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching standard steel door frames of type indicated.

H. Grout: Comply with ASTM C 476, with a slump of 4 inches for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.

2.3 INTERIOR HOLLOW METAL DOORS AND FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Interior Doors and Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Frames: Wood

2. Doors:
   a. Type: As indicated in the Door Schedule
   b. Thickness: 1-3/4”
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch with minimum A40 coating.
   d. Edge Construction: Model 1, full flush.
   e. Core: Manufacturer’s standard insulation material.
   f. Glazing: Single pane, temper as required.
   g. Exposed Finish: Prime and paint.

C. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule

1. Physical Performance: Level B according to SDI A250.4.
2. Frames: Wood.

3. Doors:

   a. Type: As indicated in the Door Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch with minimum A40 coating.
   d. Edge Construction: Model 1, Full Flush
   e. Core: Manufacturer's standard insulation material.
   f. Glazing: Insulated glass, temper as required.
   g. Exposed Finish: Prime and paint.

4. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than R10 when tested according to ASTM C 1363.

5. Frames:

   a. Materials: Wood.

6. Exposed Finish: Prime and paint.

2.5 FINISHES

A. Steel Finish: Factory priming for field-painted finish.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Remove welded-in shipping spreaders installed at factory.

B. Provide frames of sizes, thicknesses, and designs indicated. Install standard steel frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION 08111

SECTION 087100 – DOOR HARDWARE

Part 1 – General

1.1 Summary

A. Section Includes
   1. Door Hardware

B. Related Sections
   1. Section 08100 - Metal Doors and Frames.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.
B. American National Standards Institute – ANSI 156.18 – Materials and Finishes.
C. ICC/ANSI A117.1 - 1998 – Specifications for making buildings and facilities usable by physically handicapped people.
D. ADA – Americans with Disabilities Act of 1990
E. BHMA – Builders Hardware Manufacturers Association
F. DHI – Door and Hardware Institute
G. NFPA – National Fire Protection Association
   1. NFPA 80 – Fire Doors and Windows
   2. NFPA 101 – Life Safety Code
   3. NFPA 105 – Smoke and Draft Control Door Assemblies
   4. NFPA 252 – Fire Tests of Door Assemblies
H. UL – Underwriters Laboratories
   1. UL10B – Fire Tests of Door Assemblies as amended to incorporate positive pressure testing.
   2. UL 305 – Panic Hardware
I. WHI – Warnock Hersey Incorporated
J. IBC 2009 Code
K. Local applicable codes
L. SDI – Steel Door Institute
M. AWI – Architectural Woodwork Institute
N. NAAMM – National Association of Architectural Metal Manufacturers

1.3 SUBMITTALS & SUBSTITUTIONS

A. SUBMITTALS: Submit six copies of schedule per Division 1. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
   1. Type, style, function, size, quantity and finish of hardware items. Use BHMA Finish codes per ANSI A156.18.
   2. Name, part number and manufacturer of each item.
   3. Fastenings and other pertinent information.
   4. Location of hardware set coordinated with floor plans and door schedule.
   5. Explanation of abbreviations, symbols, and codes contained in schedule.
   6. Mounting locations for hardware.
   7. Door and frame sizes, materials and degrees of swing.

8. List of manufacturers used and their nearest representative with address and phone number.
9. Catalog cuts.
10. Date of jobsite visit.

B. Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.

C. Make substitution requests in accordance with Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

1. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.

D. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE:

A. Qualifications:

1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course Work for project hardware consultation to Owner, Architect and Contractor.

(1) Responsible for detailing, scheduling and ordering of finish hardware.

B. Hardware: New, free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

D. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions.

1. Where scheduled item is now obsolete, bid and furnish manufacturer's updated item at no additional cost to the project.

E. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Include manufacturers' representatives of locks, panic hardware and door closers in the meetings. Convene at least one week prior to commencement of related work.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Delivery: coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores: secured delivery direct to Owner's representative.

B. Acceptance at Site: Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage: Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS:

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical as the same operation and quality as type specified, subject to Architect's approval.

1.7 SEQUENCING AND COORDINATION:

A. Coordinate with concrete.

B. Reinforce walls for wall-mounted hardware, including wall stops and stainless-steel guard rails.

C. Coordinate finish floor materials and floor-mounted hardware.

D. Furnish manufacturer templates to door and frame fabricators.

1. Ensure proper blocking in wood doors to support wood screws for panic hardware and door closers.
2. Ensure proper reinforcement in metal doors and frames to support machine screws for panic hardware and door closers.

E. Use hardware consultant to check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

1. Confirm that wood door manufacturers furnish necessary UBC Standard 7-2 compliant seal packages.

1.8 WARRANTY:

A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' warranties:

1. Locksets: Three years.
2. Exit Devices: Three years mechanical, one year electrical.
3. Closers: Ten years mechanical, two years electrical.
4. Hinges: Life of Building.
5. Other Hardware: Two years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Listed acceptable alternate manufacturers: submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE SUB:
Hinges	(IVE) Ivesr	Bommer, Stanley
Key System	(SCH) Schlage	Sargent
Locks	(SCH) Schlage	Sargent
Closers	(LCN) LCN	Norton
Silencers	(IVE) Ives	Hager, Rockwood
Kickplates	(IVE) Ives	Hager, Rockwood
Stops & Holders –	(IVE) Ives	Hager, Rockwood
Overhead Stops	(GLY) Glynn-Johnson	None available
Thresholds	(NGP) National	Zero, Reese
Seals & Bottoms	(NGP) National	Zero, Reese

2.2 HINGING METHODS:

A. Note: drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180- degree opening. Advise architect if 8-inch width is insufficient.

B. Conventional Hinges: Steel or stainless-steel pins and concealed bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.

1. Three hinges per leaf to 7-foot, 6-inch height. Add one for each additional 30 inches in height, or any fraction thereof.
2. Extra heavy weight hinges on doors over 3 foot, 5 inches in width.
3. Extra-heavy weight hinges on doors with panic hardware or fire exit devices.
4. Out swinging exterior doors: non-ferrous with non-removable (NRP) pins.
5. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
6. Provide shims and shimming instructions for proper door adjustment.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Mortise Locksets and Latchsets: as scheduled.

1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
2. Latchbolts: 3/4 inch throw stainless steel anti-friction type.
3. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
    a. Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
4. Thumbturns: accessible design not requiring pinching or twisting motions to operate.
5. Deadbolts: stainless steel 1-inch throw.
6. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
7. Certifications:
    a. ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
    b. ANSI/ASTM F476-84 Grade 31 UL Listed.

B. Extra Heavy-Duty Cylindrical Locks and Latches: as scheduled.

1. Chassis: cylindrical design, corrosion-resistant plated cold-rolled steel, through-bolted.
2. Locking Spindle: stainless steel, interlocking design.
3. Latch Retractors: forged steel. Balance of inner parts: corrosion-resistant plated steel, or stainless steel.
4. Backset: 2-3/4" typically, more or less as needed to accommodate frame, door or other hardware.
5. Lever Trim: accessible design, independent operation, spring-cage supported, minimum 2" clearance from lever mid-point to door face.
6. Strikes: 16 gage curved steel, bronze or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.
7. Certifications:
    a. ANSI A156.2, 1994, Series 4000, Grade 1.
    b. UL listed for A label and lesser class single doors up to 4ft x 8ft.

2.4 CLOSERS

A. Surface Closers: [4041]

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast-iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.

5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to –30 degrees F, furnish data on request.
11. Non-flaming fluid will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV): unsafe, not permitted.

B. Surface Closers: [1461]

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast-iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 5,000,000 cycles.
4. Non-sized, non-handed and adjustable. Place closers inside building, stairs and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to 0 degrees F, furnish data on request.
11. Non-flaming fluid will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV): unsafe, not permitted.

2.6 OTHER HARDWARE

A. Overhead Stops: Stainless steel (100 series). Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

B. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

C. Door Stops: Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide wall type with appropriate fasteners. Where wall type cannot be used, provide floor type. If neither can be used, provide overhead type.
2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum: 90deg stop / 95deg deadstop. Note degree of opening in submittal.

D. Seals: Finished to match adjacent frame color. Resilient seal material: polypropylene, nylon brush, or solid high-grade neoprene. UL label applied to seals on rated doors. Substitute products: certify that the products equal or exceed specified material's thickness and durability. Proposed substitutions: submit for approval.

1. Solid neoprene: MIL Spec. R6855-CL III, Grade 40.
2. Non-corroding fasteners at in-swinging exterior doors.

F Thresholds: As scheduled and per details. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for approval.

1. Exteriors: Seal perimeter to exclude water and vermin. Use butyl-rubber or polyisobutylene sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Non-ferrous 1/4inch fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL).
2. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.

H. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full thread. Sleeve nuts: full length to prevent door compression.

I. Through-bolts: Do not use. Coordinate with wood doors, ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames, ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.

J. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Omit where adhesive mounted seal occurs. Leave no unfilled/uncovered pre- punched silencer holes.

2.7 FINISH:

A. Generally, BHMA 626 Satin Chromium.

1. Areas using BHMA 626 to have push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise noted.

B. Door closers: factory powder coated to match other hardware, unless otherwise noted.

2.8 KEYING REQUIREMENTS:

A. Key System: Schlage Everest utility-patented keyway, conventional cylinders. Utility patent protection to extend at least until 2014. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers. For estimate use factory GMK charge. Initiate and conduct meetings(s) with Owner and I-R Security & Safety Consultants representatives to determine system keyway(s), structure and degree of geographic exclusivity. Furnish Owner's written approval of the system.

1. Existing factory registered master key system.
2. Non-I.C. construction keying: furnish inserted type partial key. At substantial completion, remove inserts in Owner's presence; demonstrate consequent non-operability of construction key. Give all removed inserts and all construction keys to Owner.
1. Furnish 10 construction keys.
2. Furnish 2 construction insert extractor tool 35-057.
3. Furnish 2 construction control keys.

B. Key Cylinders: furnish utility patented, 6-pin solid brass construction.

C. Permanent keys: furnish secured shipment direct from point of origination to Owner.

D. Bitting List: furnish secured shipment direct from point of origination to Owner upon completion.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

A. Experienced craftsperson with a resume of successful projects. Can readily differentiate between number 2 and number 3 phillips-drive screws and screwdrivers. Can readily differentiate between #10-24 machine screws and drywall screws and can explain correct usages of these items.

3.2 PREPARATION:

A. Ensure that walls and frames are square and plumb before hardware installation.

B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.

1. Notify Architect of any code conflicts before ordering material.
2. Locate levers, key cylinders, t-turn pieces, touchbars and other operable portions of latching hardware between 30 inches to 44 inches above the finished floor.
3. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

C. Overhead stops: before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

D. Existing frames and doors scheduled to receive new hardware: carefully remove existing hardware, tag and bag, and turn over to Owner.

3.3 INSTALLATION

A. Install hardware per manufacturer’s instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate.
Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.

1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
3. Use manufacturers' fasteners furnished with hardware items or submit Request for Substitution with Architect.
4. Replace fasteners damaged by power-driven tools.

B. Locate overhead stops for minimum 90 degrees and maximum allowable degree of swing.

C. Drill pilot holes for fasteners in wood doors and/or frames.

D. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4 ADJUSTING

A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.

1. Hardware damaged by improper installation or adjustment methods to be repaired or replaced to Owner’s satisfaction.
2. Adjust doors to fully latch with no more than 1 pound of pressure.
3. Adjust delayed-action closers on fire-rated doors to fully close from fully- opened position in no more than 10 seconds.

B. Inspection: Use hardware supplier. Include supplier's report with closeout documents.

C. Follow-up inspection: Installer to provide letter of agreement to Owner that approximately 6 months after substantial completion, installer will visit Project with representatives of the manufacturers of the locking devices and door closers to accomplish following:

1. Re-adjust hardware.
2. Evaluate maintenance procedures and recommend changes or additions and instruct Owner's personnel.
3. Identify items that have deteriorated or failed.
4. Submit written report identifying problems and likely future problems.

3.5 DEMONSTRATION:

A. Demonstrate electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING:

A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.

B. Clean adjacent wall, frame and door surfaces soiled from installation/reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

A. See door schedule in drawings for hardware set assignments.

B. Manufacturers and their abbreviations used in this schedule:

GLY Glynn-Johnson Hardware IVE
H. B. Ives
LCN LCN Closers
NGP National Guard Products SCH
Schlage Lock Company VON
Von Duprin

GROUP: 01
Door Number

Each To Have:			
Hinge	3	(IVE) 5BB1 4.5 X 4.5	652
Entrance Lock	1	(SCH) L9453P 06A	626
Surface Closer	1	(LCN) 4040XP REG	689
Wall Stop	1	(IVE) WS401CCV	626
Seals	1	(NGP) A626A	CL
Door Sweep	1	(NGP) C627A	CL
Threshold	1	(NGP) 426	AL

GROUP: 02
Door Number

Each To Have:			
Hinge	3	(IVE) 5BB1 4.5 X 4.5	652
Entrance Lock	1	(SCH) ND53PD RHO	626
Wall Stop	1	(IVE) WS401CCV	630
Silencer	3	(IVE) SR64	GRY

END OF SECTION 087100

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wall base.
2. Molding accessories.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

1.3 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 60 deg F or more than 90 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After post installation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

A. Colors and Patterns:

1. Color: As selected from manufacturer’s full line
2. Pattern: Continuous, solid color.

2.3 RESILIENT WALL BASE.

A. Wall Base: ASTM F 1861.

1. Johnsonite.
2. VPI Corporation.
3. Approved equal.

B. Type (Material Requirement): 4” covered rubber base with pre-molded outside corners and job-formed inside corners. Vinyl or rubber/vinyl are not acceptable. Pieces to be continuous roll1 piece of base per length of wall.

C. All edge trim such as reducer strips, divider strips, transition strips, termination bars, shall be of rubber or metal. Vinyl or vinyl/rubber are not acceptable.

D. Group (Manufacturing Method): I (solid, homogeneous).

E. Style: Cove (with top-set toe).

F. Minimum Thickness: 0.125 inch.

G. Height: 4 inches.

H. Lengths: Coils in manufacturer's standard length.

I. Outside Corners: Premolded.

J. Inside Corners: Job Formed.

K. Surface: Smooth.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement-based formulation provided or approved by resilient product manufacturers for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Premolded Corners: Install premolded corners before installing straight pieces.

3.3 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09653

SECTION 097200 – FIBERGLASS REINFORCED PANELS (FRP)

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes Fiberglass Reinforced Panels (FRP)

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Samples: For selection of texture and color.

PART 2 - PRODUCTS

2.1 FIBERGLASS REINFORCED PANEL (FRP)

A. General:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Marlite Wall Systems
b. Crane Composites, Inc.
c. Approved equal.

B. FRP Panels

1. Sheet Size: 4’ x 9’ sheets.

2. Thickness: 3/32” inch.

C. Colors and Texture: As selected by Architect from manufacturer's full range.

2.2 ACCESSORIES

A. Adhesive: Mildew-resistant, non-staining, adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.

1. Adhesive shall have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. PVC Trims and Moldings: In color to match wall panels

1. Inside Corners: M350
2. Outside Corner: M360
3. Division: M365
4. Edge Trim: M370

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

B. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.

C. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

D. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

E. Install seams vertical and plumb at least 18 inches from corners. No horizontal seams are permitted.

F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams per manufacturer recommendations.

END OF SECTION 097200

SECTION 09912 - PAINTING (PROFESSIONAL LINE PRODUCTS)

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and field painting of exposed interior items and surfaces.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each type of finish-coat material indicated.

1.3 QUALITY ASSURANCE

A. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5.

1. Small Areas and Items: Architect will designate items or areas required.
2. Final approval of colors will be from benchmark samples.

1.4 PROJECT CONDITIONS

A. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

C. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

D. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.5 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and, in the quantities, described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: 5 percent, but not less than 1 quart. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Sherwin-Williams Co.
2. Approved equal.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Color to be selected by Architect from manufacturer’s full line of standard colors.

2.3 PREPARATORY COATS

A. Interior Primer: Interior latex-based or alkyd primer of finish coat manufacturer and recommended in writing by manufacturer for use with finish coat and on substrate indicated.

1. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 INTERIOR FINISH COATS

A. Interior Semigloss Acrylic Enamel:

1. Sherwin-Williams; ProMar 200 Interior/Exterior Latex Semi-Gloss Enamel B31W200 Series or approved equal.
2. Approved equal.

PART 3 - EXECUTION

3.1 APPLICATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

C. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

    a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
    c. If transparent finish is required, back prime with spar varnish.
    d. Back prime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
    e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

E. Material Preparation:

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

F. Exposed Surfaces: Include areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
2. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
3. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
5. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

G. Sand lightly between each succeeding enamel or varnish coat.

H. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Omit primer over metal surfaces that have been shop primed and touchup painted.
2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.

I. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

J. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

K. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

L. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

M. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

N. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

3.2 CLEANING AND PROTECTING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.3 PAINT SCHEDULE

A. Metal Doors, Metal Frames, Lintles, Bollards, and other Metal Fabrications:

1. Acrylic Enamel Finish: Two finish coats over a primer.

a. Primer: Interior/Exterior metal primer.
b. Finish Coats: Interior/Exterior semi-gloss acrylic enamel.

3.4 INTERIOR FLOOR SEALER

A. Concrete Floor: Surface should be thoroughly cleaned and free from dust, dirt, effervescence or other surface contaminants. If acid cleaners have been used, the substrate must be thoroughly rinsed per Masonry Institute recommendations.

1. Finish Coats: Sherwin Williams H&C High Performance Clear Coat

END OF SECTION 09912

SECTION 12356 – CASEWORK

PART 1 – GENERAL

1.1 SUBMITTALS

A. Product Data: In addition to Product Data, submit the following:

1. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, methods of joining countertops, and cutouts for plumbing fixtures.

2. Samples showing the full range of colors, textures, and patterns available for each type of material exposed to view.

B. Field Measurements: Verify dimensions of existing construction by field measurements after base cabinets are installed but before countertops fabrication is complete.

C. Coordinate layout and installation of blocking and reinforcement in partitions for support of casework.

1.2 PRODUCTS

A. Products: Provide products manufactured by TMI Systems Design Corporation or an approved equal. See drawings for cabinetry configurations.

B. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range for these characteristics.

C. Exposed Cabinet Materials: Comply with the following:

1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS.

a. Doors and drawer fronts finished end: Laminate as selected from manufacturer's full line of laminates.

D. Semi-exposed Cabinet Materials: Unless otherwise indicated, provide the following:

1. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3, Grade VGS.

E. Concealed Cabinet Materials: Comply with the following:

1. Particleboard: ANSI A208.1, Grade M-2.
2. Hardboard: AHA A135.4, Class 1 Tempered.

F. Countertop Materials: Unless otherwise indicated, provide the following:

1. Plastic Laminate: Laminate as selected from manufacturer's full line of laminates.
2. Particleboard: ANSI A208.1, Grade M-2.

G. Casework Hardware: Manufacturer's standard units complying with BHMA A156.9, of type, material, size, and finish as selected from manufacturer's standard choices.

H. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides, designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05091.

I. Cabinet Construction: Manufacturer's standard to comply with the following.

1. Hinges: 5 Knuckle epoxy powder coated.
2. Lock Mechanism: Epoxy powder coated metal clasps for securing unit with padlock. Lock mechanism required on tall doors only.
3. Pulls: Metal wire epoxy powder coated.

K. Plastic-Laminate Countertops: Provide countertops with the following front, cove (intersection of top with backsplash), backsplash, and end-splash style:

1. Front: Self-edge.
2. Cove: Applied (backsplash rests on top of forming seam at inside corner).
3. Backsplash: Square edge.
4. End Splash: Square edge.

1.3 EXECUTION

A. Install casework with no variation in flushness of adjoining surfaces: use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework face.

B. Install casework and countertop level and plumb to a tolerance of 1/8 inch in 8 feet.

C. Fasten cabinets to adjacent units and to backing.
1. Fasten wall cabinets through back near top and bottom, at ends and not less than 24 inches.

D. Fasten plastic-laminate countertops by screwing through corner blocks of base units into underside of countertop. Form seams using splines to align adjacent surfaces, and secure with glue and concealed clamping devices designed for this purpose.

E. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

END OF SECTION 12356

DIVISION 22 PLUMBING

SECTION 220000 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

B. Take cognizance of any change required in this work which may be a direct result of any alternate bid item listed and include the price deemed necessary to meet the requirements of the respective alternate.

1.2 SCOPE OF WORK:

A. Refer to Architectural Specification Division 01, Summary.

B. The Contractor shall provide labor, materials, equipment, items, articles, operations and methods listed, shown, scheduled, or mentioned on the drawings, and/or specified, including all incidentals required for their completion.

C. The Contractor shall refer to the General part of these specifications, such as Instructions to Bidders, Special Conditions and DIVISION 1 for restrictions covering time that work can be performed in certain areas, noisy and dusty operations, sequence of work, access to restricted areas and similar types of work and operations.

D. Work depicted within these Construction Documents is to occur at the Project Site as described on A0.1. Additional demolition and relocation of existing plumbing fixtures is to occur at the Molecular Biosciences Building, also shown on A0.1. See Sections 1.20 and 3.2 for additional information.

1.3 WARRANTY:

A. A minimum 1 year parts and labor warranty shall be provided for all mechanical equipment and materials. Additional warranties shall be provided as described in individual specification sections. Warranty shall begin at the completion of the project when systems are fully operating and all work has been completed. Under no circumstances shall warranty periods start until the system is operating properly.

1.4 INTERPRETATION OF DRAWINGS:

A. The Drawings show the location and general arrangement of equipment, piping, ductwork and related items. They shall be followed as closely as elements of the construction will permit. Examine the drawings of other trades and verify the conditions governing the work on the job site. Drawings are schematic in nature, and installation may require additional offsets and modifications, including fittings, traps, valves and accessories.

B. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Report conflicts or differences to the architect/ engineer for resolution.

C. Coordinate placement of mechanical items such as floor drains, duct openings and pipe sleeves with the general contractor.

1.5 SUBSTITUTIONS

A. Most items in this DIVISION are eligible for substitution in accordance with the General Conditions and Supplements thereto. Where a proprietary specification is written for a particular item, then only that item may be used. All items eligible for substitution require submission of request for substitution 10 days prior to bid date. This submittal shall include specific models and capacities of equipment and not just manufacturers' literature.

B. When the Engineer deems it necessary, to assure satisfactory installation and compatibility with other equipment, piping, ductwork, electrical provisions and other appurtenances, the Contractor shall prepare scale drawings of the substitute item showing proposed location, connections, relation to other equipment and other pertinent data such as maintenance space requirements, electrical requirements, height and weight. Drawings must receive Engineer's approval before the substitution is made.

C. It is the Contractor's responsibility that the substitute item shall fit into the space allocated and that the item can be installed and function as intended. Should changes in the work of any Contractor become necessary as a result of any substitute item under this DIVISION, such changes shall be arranged and paid for by this Contractor.

D. Capacities of substitute items shall not be less than that of the specified item.

E. The performance of the factory representative and supplier on past work will be a consideration in the approval process of substitute items.
F. The final decision as to acceptability rests with the Engineer.

1.6 WORKMANSHIP:
A. Work shall be accomplished by workmen skilled in the particular trade, in conformance with best practices and to meet all applicable codes.
B. The Engineer decides where work is satisfactory. This Contractor shall replace materials or equipment not properly installed or finished, without increase in payment received.

1.7 INSPECTIONS:
A. This Contractor shall inform General Contractor of the project progress and schedule weekly. This Contractor shall notify the Engineer as the project progresses, at each of the following points:
1. At the completion of rough-in, before envelope insulation/wall surfaces are installed.
2. At the completion of fixture installation, when systems are operational. (Substantial Completion)
3. At the end of construction, after substantial completion punchlist items are corrected. (Final Inspection.)

1.8 RESPONSIBILITY:
A. The Contractor is responsible for installation of a satisfactory and complete piece of work in accordance with true intent of the drawings and specifications.
B. Consult all drawings for the project to predetermine that the work and equipment will fit as planned.
C. The location of piping, ducts, equipment, etc., shall be checked to ensure clearance from openings, structural members, cabinets, lights, outlets, and equipment having fixed locations. This shall be accomplished prior to fabrication of pipe or ducts.
D. If, at any time, and in any case, changes in location of piping, ducts, equipment, etc., becomes necessary due to existing obstacles or installation of other trades shown on any of the project drawings such required changes shall be made by the Contractor at no extra cost. These changes are to be recorded on the record drawings.
E. This Contractor is responsible to provide all incidental electrical interconnections, control wiring, etc., which are necessary for system completion and which are not specifically shown or otherwise indicated on the electrical drawings or specified in DIVISION 26.
F. All electrical work incidental to or accomplished under this Division shall comply with all requirements of DIVISION 26.

1.9 PROJECT RECORD DOCUMENTS:
A. For underground piping, record dimensions and invert elevations of all piping, including all offsets, fittings, cathodic protection and accessories. Locate dimensions from benchmarks that will be preserved after construction is complete.
B. A separate set of mechanical drawings shall be maintained at the job site at all times and shall be used as record drawings. This set shall be kept up to date with all changes and/or additions in the construction and/or mechanical systems and shall be delivered to the Engineer at the completion of this job. This set of drawings shall be kept clean and protected at all times.

1.10 DELIVERY, STORAGE AND HANDLING:
A. Deliver, store, and handle all materials to keep clean and protected from damage.
B. Store products in a manner acceptable to the Owner and Engineer. Provide temporary inlet and outlet caps. Maintain caps in place until installation.
C. Protect equipment and other materials from damage after installed from construction debris and other damage.
D. Refer to Division 1 for additional provisions to allow equipment passage into the building.

1.11 QUALITY ASSURANCE:
A. Regulatory Requirements: Comply with the following –
1. 2018 International Building Code (IBC).
2. 2018 International Fuel Gas Code (IFGC).
3. 2018 International Mechanical Code (IMC).
4. 2017 National Electric Code (NEC).
5. 2018 Uniform Plumbing Code (UPC).
6. 2012 International Energy Conservation Code (IECC).

7. 2018 International Fire Code.
8. Current National Fire Protection Association Fire Codes (NFPA).
9. All other applicable Federal, State, County, and City codes, regulations, and ordinances.

B. All materials of a given type shall be manufactured by a single source, and supplied by a single supplier.
C. Comply with Division 26 and all codes referenced therein for any electrical work accomplished under this Division or by this contractor.
D. All materials and equipment shall be new, approved by the governing authority, and be in new, undamaged condition when installed.

1.12 LABELING REQUIREMENT FOR PACKAGED EQUIPMENT:

A. Electrical panels on packaged mechanical equipment shall bear UL label or label of other approved testing agency (ETL, CSA).

1.13 PERMIT AND APPROVAL:
A. Arrange for and obtain all permits and approvals required for the execution of the work.

1.14 MANUFACTURER'S DIRECTIONS
A. Manufactured materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer unless noted otherwise herein or on the drawings.
B. Certain items of equipment, as noted herein, shall be checked out, started and put into service by factory representatives.

1.15 CUTTING, PATCHING, REPAIRING
A. Cutting, patching and repairing required by the work of this DIVISION shall be the responsibility of this Contractor.
B. Work shall be performed in accordance with DIVISION 1 of these specifications.
C. The performance of this work shall not weaken the structural integrity of the building.
D. Any abrasion or disfigurement of the finished work or any portion of the building where any such abrasion or disfigurement is caused by the activities of the Contractor shall be repaired and neatly refinished to match the adjacent work.

1.16 OPENINGS IN PIPES
A. Openings in pipes shall be kept closed during progress of work.
B. The Contractor is required to clean new systems found dirty to the satisfaction of the Engineer at no additional cost.

1.17 CLEANUP
A. Upon completion of work, remove materials, scraps, etc., relative to this work and leave the premises in a clean and orderly condition. This applies equally to finished, unfinished and concealed spaces.
B. Clean equipment of dirt, debris, and any overspray of finishes (paint, etc).

1.18 SAMPLES
A. The Contractor shall submit actual production samples on any material or equipment requested if, in the Engineer's opinion, it is necessary in order to determine the quality, workmanship, operation, etc. of the item.
B. Samples will be returned to the Contractor. Approved samples may be used on the job.
C. Costs incurred in providing and returning samples will be the responsibility of the Contractor.

1.19 OPERATING INSTRUCTIONS
A. Written operation and maintenance instructions, as produced by the manufacturer, shall be provided for all equipment. These instructions shall be bound and submitted as described in this Section.

1.20 REMODELING WORK
A. Wherever existing mechanical systems, plumbing, heating, service lines, piping, ducts, controls, etc., are cut into, removed, or interrupted as a result of the contract work, all such items that serve areas or equipment that remain shall be replaced, rerouted, extended, relocated, etc., as necessary to maintain operation of equipment and services.

B. Downtime shall be held to a minimum. Outages shall be scheduled at a time acceptable to and approved by the Owner. Consult with the Owner in sufficient time to permit necessary preparations for the outage.

C. Demolition:
   1. Refer to the drawings and descriptions herein for execution of demolition.
   2. All existing equipment and material removed and not scheduled for reinstallation shall remain the property of the Owner and shall be delivered to a designated stockpile area on the site by the Contractor. Materials not wanted by the Owner shall be removed from the site by the Contractor.

D. Asbestos Awareness
   1. If suspect asbestos materials are encountered, the contractor shall cease work in that area and inform the owner of his suspicions and will not proceed with work until such time that a determination can be made on how to proceed.

E. Site Investigation
   1. Before submitting a proposal, the Contractor should examine the site and building(s) as it pertains to this Project and make allowances in the proposal for all conditions that will affect the work indicated in the Project manual and contract documents. This would include hidden and other discovered obstacles such as existing pipes, ducts and equipment not necessarily shown on the project drawings.
   2. Building access may be arranged by contacting the Owner.

1.21 SUBMITTALS AND BROCHURES OF EQUIPMENT (OPERATION & MAINTENANCE MANUALS), GENERAL

A. The literature required to be submitted and approved in order to fulfill the requirements of this DIVISION falls into two general categories. These are the “Brochures of Equipment” and “Submittals.”

   1. The “Brochures of Equipment”, as the name implies, shall contain all pertinent information for all equipment installed. These books are required to be turned over to the Owner and approved before final payment is authorized. Special training for certain equipment may require the use of this book at an earlier stage of project completion. In these instances, the Contractor will be required to prepare and submit the applicable portions of the Brochures of Equipment significantly before project completion.
   2. “Submittals” is a general term for informational literature which must be supplied to and approved by the Contractor prior to installing, receiving, or in some instances, even ordering equipment. The normal required types of submittals include shop drawings, manufacturer’s literature, installation and operation instructions (from the manufacturer) and wiring diagrams. System reports, such as start-up reports or balancing reports, and the Project Completion Checklist are two forms of submittals which are required after the equipment has been installed and is operational. Each Section of this Division may contain special or more specific requirements for expanded or additional types of submittal literature. These shall be provided as required by each Section.
   3. In general, copies of all returned, approved submittals shall be included in the Brochures of Equipment. These books shall also include complete operation and maintenance literature for each piece of equipment such as may be packaged with the equipment for OEM components. They will be used by the Owner’s personnel as the primary source of information for operating and maintaining the installed systems and as such, they shall exhibit a high degree of clarity, thoroughness and be suitably bound and arranged to be useful and durable throughout the life of the installed systems.

1.22 SUBMITTALS

A. The contractor shall procure manufacturer’s literature and/or certified prints for all items of equipment, materials or systems on the job. Shop drawings and literature shall be complete and marked showing name of job, item used, size, dimensions, capacity, rough-in, etc., as required for complete check and installation. Any exceptions of the equipment being furnished from that specified shall be clearly identified. Specific requirements of submittals may be expanded in individual specification sections. Minimum requirements shall include the following:
   1. Submit actual installation layout drawings on floor plans showing pipe and duct runs. Provide such drawings for systems such as underground pipe and boiler fluesystems.
   2. Manufacturer’s literature shall include any and all restrictions on the application and installed service limitations of the product.
   3. All shop drawings shall be reviewed, approved and stamped by the Contractor before submittal to the Architect/Engineer.

4. All items of equipment and systems which are to be installed as specified or are not otherwise designated as requiring Owner's or Engineer's approval, will require a letter of compliance by the Contractor stating that these items or system will be provided as specified and will be reviewed and stamped by the contractor.
5. Submittals for any piece of equipment or system which is a substitute from that specified or of any equipment or system specifically directing Engineer's review shall be forwarded to the owner or Engineer (as designated) for review. This submittal shall be made within 30 days of award of contract or specified item shall be furnished. The Contractor shall check submittals for number of copies, adequate identification, correctness and compliance with drawings and specifications and apply his stamp of approval before forwarding the submittal. Submittals shall be revised, changed and/or resubmitted until acceptable and approved by the Owner's representative.
6. Approval of submittals and literature by the owner or Engineer shall not relieve the Contractor from responsibility for deviations from drawings or specifications, nor shall it relieve him from responsibility for errors in shop drawings or another submittal literature.
7. Submit submittals in PDF form for review. Combine all equipment submittal sheets into one file (as file size permits).
8. Copies or scanned documents which are not of a permanent or legible nature will not be accepted for shop drawing submittals. Copies must be legible with all dimensions and other pertinent data clear.

1.23 BROCHURES OF EQUIPMENT

A. The Contractor shall prepare and submit two complete Brochures of Equipment. Each shall contain all required submittal data for the construction materials and each piece of equipment (reference Submittal Schedule, 220000 1.22) installed under this project. The literature required for submittal purposes shall be expanded to include operation and maintenance literature for each piece of equipment. Maintenance information shall be complete in every respect and shall include parts lists and assembly drawings wherever applicable. Manuals, catalogs, etc., shall be new, as supplied by the factory, and not photocopied.
B. All literature shall clearly indicate the equipment it represents and shall be labeled with the equipment identification abbreviation found on the drawings, e.g. EF-1, etc. All information which is not applicable to the particular model and size supplied shall be clearly and neatly crossed out with heavy black marker or other suitable means. This includes dimensional drawings, maintenance information, parts lists, wiring diagrams, etc. Only the information applicable to the particular equipment supplied shall remain and it shall be easy to follow. Booklets not meeting these requirements shall be returned for correction.
C. Binders shall be high quality telescoping post type with slide or lever release, metal hinges, and covered hardboard or rigid plastic covers.
D. Dividers shall be used to separate the literature for equipment supplied under each of the various Sections of this DIVISION. Divider headings shall read the same as the Section title e.g. "222400 PLUMBING FIXTURES."
E. Large size drawings or diagrams shall be folded and placed in heavyweight sheets with pockets.
F. The format of the Brochure shall begin with the submittal requirement list at the front as an index sheet. The dividers for each section shall then progress sequentially and the project completion checklist shall be included at the back as the appendix.
G. Authorization for final payment shall not be made prior to final acceptance of the Brochures of Equipment.

1.24 ACCESS PANELS:

A. Furnish access panels to access valves, traps, control valves or devices, dampers, damper motors, etc. Access panels shall be sized as necessary for ample access, or as indicated on drawings, but no smaller than 12" x 12" where devices are within easy reach of operator, and at least 24"x24" when operator must pass through opening in order to reach the devices. Provide Milcor Style "DW" or "M" doors.
B. Access panels in fire rated walls or ceiling must be U.L. labeled for intended use, similar and equal to Ruskin #APW1. Unless otherwise indicated on plans, access doors shall be hinged flush type steel framed panel, 14 gauge minimum for frame, and with anchor straps. Only narrow border shall be exposed. Hinges shall be concealed type. Locking device shall be flush type and screwdriver operated. Metal surfaces shall be prime coated with rust-inhibitive paint. Panels shall be compatible with architectural adjacent materials Manufacturer: Milcor, Bilco

PART 2 EXECUTION

2.1 GENERAL REQUIREMENTS

A. Install equipment and materials in accordance with manufacturer's writtenand illustrated instructions, as detailed on drawings and as described in these specifications. Bring discrepancies in installation methods to the attention of the owner and A/E.

B. Install hanger rod straight, without bending.

2.2 COMPLETION AND TESTS

A. The contractor shall inform the engineer of progress throughout construction as necessary to complete inspections. Inspections shall include rough-in, substantial completion and final completion.

1. The rough-in inspection shall be completed prior to sheetrock or ceiling installation.
2. The substantial completion inspection shall be performed after all work has been completed and systems are operating correctly. During the substantial completion inspection, a functional system test shall be performed by the installer(s) in the presence of the Engineer and owner's designated representatives. During the test the contractor shall demonstrate that all systems and equipment perform in the manner described in the specifications and indicated on the drawings. Any systems found not to be operating properly shall be repaired and followed up with an additional functional system test. After substantial completion a list of mechanical construction deficiencies (punchlist) shall be prepared and sent to the mechanical contractor.

END OF SECTION 22 00 00

SECTION 220700 – INSULATION

PART 1 GENERAL

1.1 **RELATED DOCUMENTS**

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

1.2 **SCOPE OF WORK**

A. Insulate all new domestic water piping (hot and cold).

B. Repair or replace insulation damaged during construction.

1.3 **SUBMITTALS**

A. Provide manufacturer's literature and ratings for all pipe and duct insulation products. Data shall include fire and smoke ratings, thermal conductivities, recommended temperature limitations, perm ratings of jackets and materials of construction.

B. Submittals shall be clearly marked to indicate what insulation and cover is to be used, insulation thickness and which system is to be insulated with each product.

1.4 **FIRE RATINGS**

A. All products used shall be UL listed with a maximum flame spread rating of 25 and maximum smoke development rating of 50.

PART 2 PRODUCTS

2.1 **GENERAL INSULATION DEFINITIONS:**

A. Insulation thermal conductivity: No greater than value listed, in Btu-inch/hour-square foot- degrees F at 75 degrees F mean temperature.

B. Water Vapor Permeance (ASTM E97 or E96, Procedure A): No more than value listed, in perms. Water vapor permeability (ASTM C355): No greater than value listed, in perm-inch.

C. Puncture resistance (ASTM D781): No less than value listed.

D. Flame spread classification (ASTM E84, NFPA 255): No greater than value listed. Smoke density classification (ASTM E84, NFPA 255): No greater than value listed. Composite listing includes insulation, jacket, and adhesive.

E. Density no less than value listed, in pounds per cubic foot.

2.2 **ACCEPTABLE PRODUCTS**

A. Equivalent products of Armstrong, Johns-Manville, Knauf, Certainteed, and Owens-Corning are acceptable.

B. Owens-Corning catalog designations and descriptions used herein.

C. Substitute insulation shall provide same thermal and mechanical protection as the insulation specified.

2.3 **PIPING INSULATION THICKNESS TABLE:**

A. Minimum insulation thickness in inches, shall comply with the table below for the associated piping system and pipe sizes. Values are based on an R value of 4 per inch thickness. Overall conductance shall comply with ASHRAE 90.

Piping System Fluid	Temp. Range Deg. F	Thickness in Inches For Pipe Sizes Through Size Listed					
		1"	2"	4"	6"	8"	10" & above
Hot Water (above includes domestic and heating)	110-200	1.0	1.0	1.5	1.5	1.5	1.5
Cold Water & RO	Any	0.5	0.5	0.5	1.0	1.5	2.0

2.4 **PIPING INSULATION - INDOOR (FIBERGLASS):**

A. Insulate with fiberglass insulation with factory-applied vapor barrier jacket with self-sealing laps. ASTM C547 Class 1 insulation, conductivity of 0.26. Vapor barrier jacket: laminated white kraft paper, aluminum foil, glass fiber reinforcement, permeance of 0.2 perms, and puncture resistance of 50 units. Composite flame spread/ smoke density of 25/50. Apply insulation in thickness listed in Insulation Thickness Table listed in paragraph 2.2.

1. Manufacturers: Johns-Manville (Micro-Lok 650 AP-T), Knauf (ASJ-SS1 PipeInsulation), Owens/Corning (Fiberglass ASJ/SSL-II)

B. At fittings and flanges, insulate with wrapped fiberglass insulation of same thickness as adjacent pipe, and cover with pre-molded PVC jackets. Seal edge of jacket with self-sealing vapor barrier tape.

1. Jacket Manufacturer: Zeston, Ceeco, Proto

C. For valves, strainers, suction diffusers and other accessories that require maintenance: In hot piping, insulate similar to fittings and flanges. In cold piping, insulate with closed cell elastomeric insulation, installed to be removable for maintenance access.

D. Wherever necessary to seal insulation and provide a complete and continuous vapor barrier, apply two coats of insulating mastic Manufacturers: Celotex - MW-1 Insulating and Finishing Cement; Pabco - Pabcote One Coat Insulating Cement.

PART 3 EXECUTION

3.1 INSULATION INSTALLATION

A. All systems shall be tested and approved before being insulated.

B. The insulation shall be applied over clean, dry surface.

C. Insulate all valves, flanges, couplings and fittings. Valve and flange insulation shall be removable and re-installable.

D. Full lengths of insulation shall be used except at end of straight sections and as required to accommodate fittings. Insulation shall be applied with the joints tightly fitted together. Cracks or voids shall be filled with insulation. Manufacturer's recommended installation procedures shall be strictly adhered to.

E. The edges and seams at all visible locations shall be finished in a neat and workmanlike manner.

F. Termination of insulation at equipment, unions, etc., shall be neat without any raw edges. Bevel insulation and cover each end the same as a fitting.

G. Vapor barrier jackets on all cold and dual temperature pipes shall be continuous. Repair all punctures, flaps, etc., correctly and effectively.

H. Pipe Insulation
1. Provide heavy density Fiberglass insulation, cork or Kaylo block under pipe where insulation saddles are specified with pipe hangers. Note: Wood blocking is not acceptable for this purpose.
2. Application of elastomeric type insulation to outdoor exposures requires metal jacketing or a suitable protective coating as recommended by the manufacturer.
3. Insulate roof drain basins and all roof drain piping located at or above the ceiling level of the top floor.

I. Metal Jacket
1. Apply with minimum 1" overlap at seams. Sheet metal screws max. 8" o.c. Seams shall lay at weather protected side of surface, sealed with appropriate sealant in direction to sheet moisture. Final appearance of jacket to be neat without dents, twists, and with seams straight.

J. Finished installation shall provide a continuous and effective vapor barrier.

END OF SECTION 22 07 00

SECTION 221113 – PIPING MATERIALS AND METHODS

PART 1 GENERAL

1.1 GENERAL

A. **RELATED DOCUMENTS**

1. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

1.2 SCOPE OF WORK:

A. This Section specifies piping materials and installation methods common to more than one section of Division 21, 22, and 23 and includes joining materials, piping specialties, and basic piping installation instructions.

1.3 SUBMITTAL DATA

A. Provide submittal data for any material or equipment specified in this section.

1.4 QUALITY ASSURANCE:

A. All steam piping above 15 psig, and all condensate piping shall comply with ANSI Standard B31.1 - Power Piping, except as noted herein.

B. All building service piping (including pressurized piping, vacuum), shall comply with ANSI Standard B31.9 - Building Service Piping, unless noted otherwise.

PART 2 PRODUCTS

2.1 GENERAL PIPING REQUIREMENTS:

A. All piping materials shall be compatible for temperature, pressure and service.

B. All piping materials of a given type shall be manufactured by a single source and supplied by a single supplier.

C. All wetted seals shall be made from materials that are immune from chloramine degradation.

2.2 PLUMBING PIPING SYSTEMS:

A. Domestic Cold Water, Hot Water and Hot Water Return - Above Ground:

1. For piping through 6”:
    a. Pipe: Type L Copper, hard drawn, ASTM B 88
    b. Fittings: Wrought Copper, ANSI B16.22
    c. Joints: Soldered through 2”; Brazed for 2-1/2” through 6”.
2. Contractor Options:
    a. For piping through 4", Copper press to connect fittings may be used.
    b. PEX piping conforming to ASTM F876 & ASTM F877. Piping system shall be equipped with fittings certified to ASTM F2080 and piping shall be marked with ASTM F2080. (Mechanical rooms and closets shall be copper. Run-out and branch piping may be PEX.)

B. Natural Gas - Above Ground:

1. For piping through 2”:
    a. Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B
    b. Fittings: Malleable iron, 150 lb. ASTM A 197; unions, 250 lb. ASTM A 197
    c. Joints: Screwed Terminal connections 1/2” and less: Type L Copper, annealed, ASTM B 88, 24” maximum length, flared connections

2. For piping 2-1/2” and larger
    a. Pipe: Black Steel, Schedule 40, ASTM A 53, ERW or seamless, grade B, standard weight for 12” and above
    b. Fittings: Standard weight, butt welded, black steel, ASTM A 234

c. Joints: Welded. Flanged ASTM A 181, 150#, forged steel at valves, and equipment.

C. Sanitary Waste and Vent - Above and Under Ground:
   a. Pipe: Cast Iron, Service Weight, CISPI Standard 301, ASTM A74, ASTM C564
   b. Fittings: Cast Iron, drainage pattern, ASTM A74, ASTM C564
   c. Joints: No-Hub, Heavy Duty clamps
   d. All vertical pipe risers shall be service weight cast iron.

D. Sanitary Waste and Vent – Above and Under Ground, where approved by local authority and codes.
   a. Pipe: PVC Schedule 40, ASTM D 2665, NSF approved, type DWV
   b. Fittings: PVC, ASTM D 3311
   c. Joints: Screwed or solvent weld, ASTM D2564
   d. PVC vertical pipe risers not permitted.

2.3 PIPE JOINTS:

A. Soldered Joints: ASTM B32; Alloy Sb5, (95% Tin, 5% Antimony). Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Manufacturers: Engelehard “Silverbrite 100”, Harris “Bridgit” No self-cleaning fluxes allowed.
   1. Type DWV Copper to be 50/50 Solder.
   2. Underground K copper shall be silver solder.

B. Brazed Joints: ASTM B32, silver brazed joints with 1000F minimum melting point, conforming to AWS - A5.8, “Specification for brazing filler metal”. Classification BAg-1. Unless noted otherwise, joints may be screwed or flanged to suit valves and equipment. Unless otherwise noted, solder joints near flanges and threads where heat from brazing would anneal or warp flanges or threads. Manufacturers: Lucas-Milhaupt Inc. “Sil-Fos”, J.W. Harris “Stay-Silv 15” and “Safety Silv”

C. Screwed Joints: Tapered thread, ASME B1.20.1, joined with compatible compound or sealant tape applied to male thread only.

D. Press Joints: Copper press to connect fittings shall be made in accordance with the manufacturer's installation instructions. Fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.12. O-rings for copper press fittings shall be peroxide cured EPDM. The joints shall be pressed using the tool approved by the manufacturer. Approved fitting, tool, and process: Viega ProPress, NIBCO Press System.

E. Flanged Joints: Select materials to suit service of piping, conform to respective ANSI Standards, A21.11, B16.20, B16.21 Gasket material: full-faced for cast-iron flanges and raised-face for steel flanges. Gaskets in steam and condensate lines shall be “FLEXTALLIC”, 316 L stainless steel with “FLEXICARB” filler

F. No-Hub Joints: Stainless Steel band and shield, neoprene rubber gasket. ASTM C 564. Manufacturers: Clamp-All

G. Solvent Cement Joints: Select materials suitable for pipe materials joined and compatible with fluid served. Conform to respective ASTM Standards D-2235, D-2564, D-2855 and D-3138.

H. Gasket Joint Lubricant - for use with grooved and no-hub joints: Provide manufacturer’s recommended gasket lubricant.

2.4 UNIONS:

A. Steel Pipe
   1. Up through 3" - black malleable iron threaded, hexagonal nuts, ground joint (brass to iron seat), flanged unions or flanges.
   2. 3-1/2" and Up - ASME flanges, welded to pipe.

3. Victaulic couplings are acceptable as a union.

B. Copper Pipe
1. Up through 3" - cast brass, copper-to-copper, hexagonal nut.
2. 3-1/2" and up - ASME cast brass flanges, soldered to pipe.

C. Copper to Steel Pipe
1. Up through 2" - dielectric unions with soldered or threaded ends to match adjacent piping.
2. 2-1/2" and up - cast brass flange soldered to copper pipe and steel or iron flange welded to steel pipe.

D. Plastic (PVC) to Steel
1. 150# plastic flange with solvent weld hub to standard ASME steel flange.

2.5 PIPE HANGERS AND SUPPORTS:

A. Provide adjustable type pipe hangers, supports and accessories for the proper support of all piping. Figure and model numbers specified on drawings are for Anvil International, and Pipe Shields Inc. Continuous threaded rod shall be used for intermediate attachments. See details on drawings.
1. Bare Steel Pipe - Grinnell Fig. 97 adjustable pipe ring, Fig. 65 clevis or Fig. 260 clevis.

2. Bare Copper Pipe - Grinnell Fig. 97C, Fig. CT-99 or Fig. CT-99C.

3. Cast Iron Pipe - Grinnell Fig. 65 clevis up through 3" size and Fig. 590 clevis for 4" and larger.

4. Plastic Pipe - Same as bare steel.

5. Hangers for insulated pipe shall be Grinnell Fig. 167 protection shield with 65 or 260 clevis. Note that the hanger on insulated pipe must be sized for the insulation diameter. Wood blocking shall not be used to support insulated pipe. See SECTION 220700 for required rigid support insulation materials.

B. Dielectric protection for hangers and supports: Where copper piping is supported with steel hangers and supports, dielectric protection must be provided. Use one of the following means as applicable:
1. Coated hangers (copper or plastic coating)
2. Insulation inserts
3. Cushion clamps
4. Other as approved by Engineer.

C. Trapeze hangers and floor supports which carry more than one pipe shall be spaced according to the smallest diameter pipe.

D. Horizontal load bearing members for more than one pipe shall be constructed of angle iron or manufactured structural channel similar and equal to Unistrut series 1000. The corners of all supports shall be cut or ground to minimize the chance of injury to personnel.

E. Galvanized insulation shields, the same as specified for hangers, shall be installed between the insulation and the support on all insulated piping. Shields shall be secured to the insulation with cloth tape not less than 2" wide or with nylon zip ties.

F. Pipes shall be secured to every other support using U-bolts or clamps.

G. Floor supports shall have vertical members constructed of unistrut or schedule 40 pipe and shall be sturdy enough to withstand substantial overloading, such as would be encountered if a worker stepped on the supported piping. Square steel plates shall be bolted or welded to the base of all vertical supports and shall be secured to the floor with no less than two anchors. Base plates shall be large enough to withstand lateral forces from any direction.

2.6 ATTACHMENTS

A. Supports, anchors and guides shall be attached to structural framing members, concrete slabs or masonry walls. Where supports are required between structural framing members, suitable intermediate framing shall be provided.

B. Hanger rods shall be the same diameter as the hanger tapping. Use Grinnell Fig. 146 rod, or as approved. All hanger rods to be galvanized.

C. Steel beam and joist attachments - Grinnell Fig. 229 beam clamp or Fig. 87 C-clamp with retaining strap.
D. Concrete inserts: Unistrut #3300 Series in length as required. Grinnell Fig. CB for single hangers, or as called out on details on plans.
E. Use expansion shield bolts for fastening to existing concrete.
F. Use wood screws, bolts and lag-bolts for fastening to wood structures.

2.7 BASES
A. Concrete bases for vibration control or housekeeping shall be provided for items so noted or wherever indicated on the drawings.
B. Bases shall be provided as a part of this DIVISION of the specifications but shall be done in accordance with the requirements of DIVISION 3 - CONCRETE.

2.8 PIPE SLEEVES:
A. Furnish and set pipe sleeves per details on drawings.

2.9 DIELECTRIC FITTINGS:
A. For pipe 2 inch and less: Provide brass coupling. (Dielectric unions are not acceptable).
B. For pipe 2-1/2 inch and larger: Provide flange union with dielectric gasket and bolt sleeves.
C. For dielectric connection in grooved piping, use manufacturer's dielectric nipple. Manufacturers: Anvil International Gruvlok Di-Lok Nipple, Victaulic Style 47 Dielectric Waterway

2.10 REDUCERS
A. Copper or steel, flanged, threaded, Victaulic or welded, eccentric or concentric as required, to match fittings specified for different piping systems.
B. Pipe size changes on following listed systems to be made with reducers.
1. Hydronic Systems - eccentric type on horizontal runs with straight side on top, and concentric type in vertical pipe.
2. Steam - eccentric type on horizontal runs with straight side on bottom, and concentric type in vertical pipe.

2.11 PIPING TRANSITIONS:
A. Provide transitions for joining two different types of pipe materials such as cast iron, clay, steel, copper or plastic. Fabricate transitions with bushings capable of resisting normal moisture corrosion.
B. For copper to steel connections, see "Dielectric Fittings".
C. Manufacturers: Cann-Tex Industries Division of Harsco Corp., "CT-Adapters", Fernco Joint Sealer Co. "PVC Donut", Joint, Inc., "Caulder".

PART 3 EXECUTION
3.1 GENERAL PIPING INSTALLATION REQUIREMENTS:
A. Work shall be done in accordance with applicable ordinances and codes. Arrange for inspections.
B. Install piping to permit complete draining. Provide capped hose end ball drain valves at all low points. For tunnel projects, ball valves are acceptable only for hot water. All other services in tunnel shall use gate valve NIBCO T-174-A 300 lb. Class FIP.
C. If water (flushing water, blow down, etc.) or hydronic system fluids have a pH between 6.0 and 9.0 and meets the requirements of City of Bozeman Use Ordinance, it may be discharged to the sanitary sewer. If the water does not meet the sewer discharge limits, contact the city engineer. City of Bozeman Wastewater Collection and Treatment System (Chapter 40, Section 40.03.930, Discharge Prohibitions) can be found at the website: http://library.municode.com/index.aspx?clientID=14755
D. Installed piping shall be free from sagging. Provide for expansion and contraction of piping in an approved and safe manner by means of loops or offsets, where mechanical expansion joints are not specifically called for.
E. Branch connections for steam and condensate and gaseous systems shall be taken off mains on top, up at a 45-degree angle, or off the side.

F. Branch connections for hydronic systems, shall be taken off mains up or down at a 45-degree angle or off the side.
G. Branch piping shall be valved at the branch connection points.
H. Provide fittings and specialties necessary to properly interconnect all items and specialties whether or not shown in detail.
I. Clean and swab-out all piping before installation. Piping left open for extended periods shall be capped.
J. At joints, the pipe shall be reamed to full inside diameter after cutting. Scale, rust and foreign manner removed before assembly. Contractor note: A minimum of one (1) pipe joint maybe cut out of each system at the A/E discretion. The purpose of which to inspect for proper reaming. The piping will be reassembled by the contractor at no increase of contract cost. If improper reaming is detected, the entire piping system will be rejected.
K. Lay out pipelines straight, plumb and in true alignment. Offset as required to avoid interference with other work, to conceal piping, to allow maximum headroom and to avoid interference with windows and doors. Lay out all pipes and establish their levels from benchmarks, existing floors or finished grades.
L. Piping shall be concealed unless indicated otherwise on drawings. Do not conceal piping until it has been inspected, tested, flushed and approved.
M. Use eccentric reducing fittings to increase or decrease pipe sizes. Bushings are not acceptable. Orient reducers to prevent trapping of water.
N. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves. Install hot and cold-water lines at least 6 inches apart. Install piping at least 3 inches clear of electrical conduit and avoid running pipe within 3’-6” of electrical equipment, from floor to ceiling.
O. Piping requiring insulation shall be run so that adequate clearance is maintained to permit proper insulation. Any piping installed without this clearance must be removed and reinstalled at the Contractor's expense to enable insulation to be applied.
P. Provision to be made in piping for the installing and connecting of all coils, temperature control valves, wells for gauges and controllers, etc., by this Contractor.
1. On 2-1/2" and smaller pipe, increase pipe size at well so there will be no restriction to flow.
2. On 4" and larger steel pipe, a fitting similar and equal to victaulic 'Vic-o-let' will be acceptable for misc. drains and instrument well inserts.
Q. Pipe extending into finished areas shall have chrome plated escutcheons large enough to cover pipe sleeves and shall fit snugly over pipe or insulation.
R. Pitch piping as follows:
1. Hydronic piping up in direction of flow at 1/16” per foot
2. Steam piping down in direction of flow at 1/16” per foot
3. Vent piping back toward waste at 1/8” per foot
4. Waste piping down in direction of flow at 1/4” per foot. Never less than 1/8” per foot.
5. Condensate and compressed air piping down in direction of flow at 1/8” per foot.
6. Natural gas piping level or at 1/4” per 15 feet toward drip leg.

3.2 UNDERGROUND PIPING INSTALLATION REQUIREMENTS:

A. Piping below grade running through tunnel walls or basement walls shall be run through sleeves per details in the plans.
B. Record as-built sketches and dimensions prior to backfilling.

3.3 INSTALLATION OF PIPE HANGERS AND SUPPORTS:

A. Arrange pipe hangers and supports to permit proper pitch of piping, free to move with pipe expansion, installed at proper intervals to totally prevent sagging and attached to building construction through approved means. Hangers shall be located near or at changes in piping direction and concentrated loads. Valves, strainers, in line pumps and other heavy equipment shall be supported independent of the pipes. After systems have been installed and filled adjust hangers and supports to evenly distribute weight, and maintain proper pitch. Refer to drawings for pipe hanger and support details.
B. Vertical Piping: When support locations are not indicated on the drawings, support piping at every floor level (minimum).

C. Horizontal Piping: Spacing of Hangers and Supports

1. A hanger or support shall be installed not over one foot from each change in direction of piping.
2. Hangers and supports for straight runs of piping shall not exceed the spacing listed below.

Type of Pipe	Size	Maximum Spacing
Steel	Up thru 1-1/4"	7'-6"
Steel	1-1/2" thru 3-1/2"	10'-0"
Steel	4" thru 5"	15'-0"
Steel	6" and Up	20'-0"
DWV Copper	1-1/4" thru 1-1/2"	5'-0"
DWV Copper	2" thru 2-1/2"	7'-6"
DWV Copper	3" thru 4"	10'-0"
Type L or M Copper	Up thru 1"	5'-0"
Type L or M Copper	1-1/4" thru 1-1/2"	7'-6"
Type L or M Copper	2" and Up	10'-0"
Plastic	All	As recommended by Mfr.

3. In addition to the above maximum spacing, additional hangers shall be used at, heavy valves, multiple soil pipe fittings, etc., as necessary to prevent sagging and strain on equipment and fittings.
4. Piping shall be supported independently from pumps and other in-line equipment so that equipment can be removed without the need for pipes to have temporary support.
5. Victaulic pipe systems shall be supported as recommended by the system manufacturer.

D. For cold piping, install hangers and supports to maintain an effective continuous thermal and vapor barrier between cold piping and hangers and supports.

3.4 INSTALLATION OF UNIONS

A. Unions to be installed to facilitate the removal of any piece of equipment without having to cut any pipe.
B. Piping shall be offset and provided with unions, flanges or Victaulic couplings where connected to equipment containing coils or tube bundles. Pipes to be connected in such a manner as to permit the removal of heads, coils, etc., with a minimum amount of disturbance to the piping system.
C. Use insulating union or flanges for joining dissimilar metals.

3.5 INSTALLATION OF PIPE SLEEVES:

A. Install pipe sleeves where piping passes through building construction including all walls, floors and ceilings.
B. For new wall construction, promptly and accurately locate and securely set sleeves in forms before concrete is poured. For masonry construction, set the sleeves over the piping for Masonry Contractor to build around.

3.6 EQUIPMENT MOUNTING

A. Floor Mounting

1. Concrete bases 4" high with chamfered edges shall be provided under all floor-mounted equipment such as pumps, boilers, air handling units, chillers, compressors, condensers and other equipment where bases are called out or indicated on the drawings.
2. Floor-mounted equipment shall be secured to the concrete bases with steel anchor bolts preset in the concrete base. Anchor bolts and anchoring shall be capable of resisting horizontal and vertical earthquake forces as required in the International Building Code. Where spring-type vibration mounts are required, they shall be secured to the concrete bases and in addition, the equipment restrained whereby the equipment is free to vibrate but cannot move from the base.

B. Wall Mounting
1. Wall-mounted equipment, such as plumbing fixtures and heating/cooling units shall be securely fastened to the wall using appropriate fasteners such as toggle bolts, expansion bolts, etc. Provide backing as required.

C. Roof Mounting
1. This Contractor is responsible for providing curbs and mountings for roof-mounted equipment such as fans, air handling units, cooling towers and condensers. Curbs shall be in accord with the details on the drawings and shall be prepared and flashed in conjunction with the roofing work.

3.7 FLUSHING AND CLEANING OF PIPING:

A. Flush and clean the following piping systems:
1. Cold Water (flush only)
2. Hot Water (flush only)

B. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.

C. Flushing for new piping: Flush all piping with cold water (or fire protection system where approved by owner) for a minimum of one hour, until water runs clear. Water supply shall be equivalent to piping to be flushed. Use (2) 2-1/2" fire hose connections for piping 3" and larger. Drain all low points.

END OF SECTION 221113

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sinks and related Faucets and Trim.

1.2 SUBMITTALS

A. Product Data: For each type of fixture product.
   1. Construction details, material descriptions, rated capacities, operating characteristics dimensions of individual components and profiles, and finishes for fixtures.
   2. Data sheets for each fixture shall be boldly marked with the same plumbing fixture identification as found on the plans and the plumbing fixture schedule (eg P-1, P-2, etc.)

1.3 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.
   1. Uniform Plumbing Code

1.4 COMPLIANCE

A. Cooperate in the installation of all fixtures with the General Contractor so that provisions can be made for required plumbing chase clearances, solid backing for mounting fixtures, chair carriers, shower units, drains, etc., and proper elevation for setting roof and floor drains.

1.5 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fixtures and their trim shall be complete in every respect, including such items as escutcheons, hanger plates, bolts, supplies, stops, traps, etc.

B. See the "Plumbing Fixture Schedule" on the drawings, or notes on the drawings, for fixture types.

C. Fixture trim for the entire job shall be supplied by the same manufacturer where possible in order to minimize spare parts inventories.

D. Equivalent items of manufacturers listed may be used in lieu of items of the manufacturer specified if approved by the Engineer. Contractor must list all variations and exceptions between specified items and substitute manufacturer's items on the shop drawings. Substitute items must be equal or superior in quality to that specified.

2.2 ACCESSORIES

A. All exposed metal parts of all fixtures, including faucets, waste fittings, indirect waste piping, waste plugs, strainers, flush valves, traps, supplies, and escutcheons shall be chrome-plated brass, unless otherwise specified. (This includes all parts within a base cabinet).

B. Acceptable manufacturers:
   1. Watts
   2. Chicago.
   3. BrassCraft.
   4. Faucet manufacturer.

C. Fixture Stops
   1. Fixture stops shall be the commercial quality chrome plated with brass stems. Stops shall have solder connection on the water supply inlet and compression fittings on the fixture side of the stop. Stop handles to be full wheel type with brass handles.

PART 3 – EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Review millwork/casework shop drawings. Confirm location and size of fixtures and openings before rough-in and installation. Confirm that millwork/casework is constructed with adequate provision for the installation of countertop lavatories and sinks.

C. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION OF PLUMBING FIXTURES - GENERAL

A. Fixtures shall not be used for construction activities. Protect fixtures from damage during construction.

B. All fixtures shall be installed to meet manufacturer's recommendations and local codes.

C. Unless otherwise noted, fixture rough-in shall be at manufacturer's listed heights. Note special rough-in requirements for handi-capped person fixtures. Meet all requirements of the ADA regarding installation heights and clearances.

D. Provide a fixture stop on each supply to each fixture. This includes such items as water fountains and rough-in provisions for vending machines, etc.

E. Install fixture supports securely to building substrate, utilizing bolts in every mounting hole provided in the fixture support. Provide additional blocking/backing when required.

F. Install Barrier Free water closets, urinals, lavatories, and other devices at mounting heights and with clearances in conformance with the applicable Building Code and ADA requirements.

G. Install supply, vent and drain connections to fixtures full size of fixture connection, unless larger required by code or indicated otherwise on drawings.

H. Install fixtures and fixture carriers level and plumb.

I. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Install deep-pattern escutcheons if required to conceal protruding fittings.

J. Install each fixture with trap, easily removable for servicing and cleaning.

K. Provide flexible fixture piping to all lavatories and sinks..

L. Provide accessible ball type isolation valves (construction per Related Section) in the supplies to shower control valves and electric water coolers.

M. Provide accessible ball type isolation valves and spring check valves (construction per Related Section) in the supplies to service sink faucets. These check valves are in addition to checks integral to the faucet. Locate isolation valves to isolate faucet and checks.

N. Provide plumbing fixtures complete with supply, waste and vent piping connections; together with all fittings, supports, fastening devices, and valves.

O. Use strap wrenches and padded tools to preclude injury to chrome plated and other decorative surfaces.

P. Exposed to view supply and drainage trim for fixtures and equipment shall be connected to the rough piping systems at the wall, unless noted otherwise.

Q. Wall sleeves on supply and drain connections are not required at the immediate connection to plumbing fixtures. Provide escutcheons.

R. For faucets without an included gasket, seal areas between faucet base and sink top with non- hardening plumber's putty.

S. Seal joints between plumbing fixtures and walls and floors using mildew-resistant 100% silicone sealant. Match sealant color to fixture color. Use sealing compound, such as Dow #784 white silicone sealant, for the following installations:

1. Rims and trim of stainless-steel sinks and drop-in lavatories.
2. Between the wall and the outer edge of wall-hung water closets and urinals.
3. Between the wall and the adjoining edge(s) of mop sinks.
4. Between the floor and the bottom circumference of floor-mounted water closets.

T. Install emergency fixture placards at approved location.

3.3 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise or overflow.

B. At completion of project, remove excess caulk and sealants and clean plumbing fixtures and equipment.

END OF SECTION 224000

DIVISION 23 HVAC

SECTION 230000 - COMMON WORK RESULTS FOR MECHANICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

B. Take cognizance of any change required in this work which may be a direct result of any alternate bid item listed and include the price deemed necessary to meet the requirements of the respective alternate.

1.2 SCOPE OF WORK:

A. Refer to Division 1 for additional requirements of work.

B. The Contractor shall provide labor, materials, equipment, items, articles, operations and methods listed, shown, scheduled, or mentioned on the drawings, and/or specified, including all incidentals required for their completion.

C. The Contractor shall refer to the General part of these specifications, such as Instructions to Bidders, Special Conditions and DIVISION 1 for restrictions covering time that work can be performed in certain areas, noisy and dusty operations, sequence of work, access to restricted areas and similar types of work and operations.

D. Work depicted within these Construction Documents is to occur at the Project Site as described on A0.1. Additional demolition and relocation of existing laboratory HVAC equipment, duct and fittings is to occur at the Molecular Biosciences Building, also shown on A0.1. See Sections 1.18 and 3.2 for additional information.

1.3 WARRANTY:

A. A minimum 1-year parts and labor warranty shall be provided for all mechanical equipment and materials. Additional warranties shall be provided as described in individual specification sections. Warranty shall begin at the completion of the project when systems are fully operating, and all work has been completed. Under no circumstances shall warranty periods start until the system is operating properly.

1.4 INTERPRETATION OF DRAWINGS:

A. The Drawings show the location and general arrangement of equipment, piping, ductwork and related items. They shall be followed as closely as elements of the construction will permit. Examine the drawings of other trades and verify the conditions governing the work on the job site. Drawings are schematic in nature, and installation may require additional offsets and modifications, including fittings, traps, valves and accessories.

B. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Report conflicts or differences to the architect/ engineer for resolution.

C. Coordinate placement of mechanical items with the general contractor.

1.5 SUBSTITUTIONS

A. Most items in this DIVISION are eligible for substitution in accordance with the General Conditions and Supplements thereto. Where a proprietary specification is written for a particular item, then only that item may be used. All items eligible for substitution require submission of request for substitution 10 days prior to bid date. This submittal shall include specific models and capacities of equipment and not just manufacturers' literature.

B. When the Engineer deems it necessary, to assure satisfactory installation and compatibility with other equipment, piping, ductwork, electrical provisions and other appurtenances, the Contractor shall prepare scale drawings of the substitute item showing proposed location, connections, relation to other equipment and other pertinent data such as maintenance space requirements, electrical requirements, height and weight. Drawings must receive Engineer's approval before the substitution is made.

C. It is the Contractor's responsibility that the substitute item shall fit into the space allocated and that the item can be installed and function as intended. Should changes in the work of any Contractor become necessary as a result of any substitute item under this DIVISION, such changes shall be arranged and paid for by this Contractor.

D. Capacities of substitute items shall not be less than that of the specified item.

E. The performance of the factory representative and supplier on past work will be a consideration in the approval process of substitute items.

F. The final decision as to acceptability rests with the Engineer.

1.6 WORKMANSHIP:

A. Work shall be accomplished by workmen skilled in the particular trade, in conformance with best practices and to meet all applicable codes.

B. The Engineer decides where work is satisfactory. This Contractor shall replace materials or equipment not properly installed or finished, without increase in payment received.

1.7 INSPECTIONS:

A. This Contractor shall inform General Contractor of the project progress and schedule weekly.

B. This Contractor shall notify the Engineer as the project progresses at each of the following points:
1. At the completion of rough-in, before insulation/wall surfaces are installed.
2. At the completion of fixture installation, when systems are operational. (Substantial Completion)
3. At the end of construction, after substantial completion punchlist items are corrected. (Final Inspection.)

1.8 RESPONSIBILITY:

A. The Contractor is responsible for installation of a satisfactory and complete piece of work in accordance with true intent of the drawings and specifications.

B. Consult all drawings for the project to predetermine that the work and equipment will fit as planned.

C. The location of piping, ducts, equipment, etc., shall be checked to ensure clearance from openings, structural members, cabinets, lights, outlets, and equipment having fixed locations. This shall be accomplished prior to fabrication of pipe or ducts.

D. If, at any time, and in any case, changes in location of piping, ducts, equipment, etc., becomes necessary due to existing obstacles or installation of other trades shown on any of the project drawings such required changes shall be made by the Contractor at no extra cost. These changes are to be recorded on the record drawings.

E. This Contractor is responsible to provide all incidental electrical interconnections, control wiring, etc., which are necessary for system completion and which are not specifically shown or otherwise indicated on the electrical drawings or specified in DIVISION 26.

F. All electrical work incidental to or accomplished under this Division shall comply with all requirements of DIVISION 26.

1.9 PROJECT RECORD DOCUMENTS:

A. A separate set of mechanical drawings shall be maintained at the job site at all times and shall be used as record drawings. This set shall be kept up to date with all changes and/or additions in the construction and/or mechanical systems and shall be delivered to the Engineer at the completion of this job. This set of drawings shall be kept clean and protected at alltimes.

1.10 DELIVERY, STORAGE AND HANDLING:

A. Deliver, store, and handle all materials to keep clean and protected from damage.

B. Store products in a manner acceptable to the Owner and Engineer. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

C. Protect equipment and other materials from damage after installed from construction debris and other damage.

D. Refer to Division 1 for additional provisions to allow equipment passage into the building.

1.11 QUALITY ASSURANCE:

A. Regulatory Requirements: Comply with the following –
1. 2018 International Building Code (IBC).
2. 2018 International Existing Building Code (IEBC).
3. 2018 International Fuel Gas Code (IFGC).
4. 2018 International Mechanical Code (IMC).
5. 2017 National Electric Code (NEC).
6. 2018 Uniform Plumbing Code (UPC).
7. 2012 International Energy Conservation Code (IECC).
8. 2018 International Fire Code.
9. Current National Fire Protection Association Fire Codes (NFPA).
10. All other applicable Federal, State, County, and City codes, regulations, andordinances.

B. All materials of a given type shall be manufactured by a single source and supplied by a single supplier.

C. Comply with Division 26 and all codes referenced therein for any electrical work accomplished under this Division or by this contractor.

D. All materials and equipment shall be new, approved by the governing authority, and be in new, undamaged condition when installed.

E. Labeling requirement for packaged equipment:
1. Electrical panels on packaged mechanical equipment shall bear UL label or label of other approved testing agency (ETL, CSA).

F. Permit and Approval:

1. Arrange for and obtain all permits and approvals required for the execution of thework.

1.12 MANUFACTURER'S DIRECTIONS

A. Manufactured materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer unless noted otherwise herein or on the drawings.

B. Certain items of equipment, as noted herein, shall be checked out, started and put into service by factory representatives.

1.13 CUTTING, PATCHING, REPAIRING

A. Cutting, patching and repairing required by the work of this DIVISION shall be the responsibility of this Contractor.

B. Work shall be performed in accordance with DIVISION 1 of these specifications.

C. The performance of this work shall not weaken the structural integrity of the building.

D. Any abrasion or disfigurement of the finished work or any portion of the building where any such abrasion or disfigurement is caused by the activities of the Contractor shall be repaired and neatly refinished to match the adjacent work.

1.14 OPENINGS IN PIPES AND DUCTS

A. Openings in pipes and ducts shall be kept closed during progress of work.

B. The Contractor is required to clean new systems found dirty to the satisfaction of the Engineer at no additional cost.

1.15 CLEANUP

A. Upon completion of work, remove materials, scraps, etc., relative to this work and leave the premises in a clean and orderly condition. This applies equally to finished, unfinished and concealed spaces.

B. Clean equipment of dirt, debris, and any overspray of finishes (paint, etc).

1.16 OPERATING INSTRUCTIONS

A. Written operation and maintenance instructions, as produced by the manufacturer, shall be provided for all equipment. These instructions shall be bound and submitted as described in this Section.

1.17 REMODELING WORK

A. Wherever existing mechanical systems, plumbing, heating, service lines, piping, ducts, controls, etc., are cut into, removed, or interrupted as a result of the contract work, all such items that serve areas or equipment that remain shall be replaced, rerouted, extended, relocated, etc., as necessary to maintain operation of equipment and services.

B. Downtime shall be held to a minimum. Outages shall be scheduled at a time acceptable to and approved by the Owner. Consult with the Owner in sufficient time to make necessary preparations for the outage.

C. Demolition:
1. Refer to the drawings and descriptions herein for execution of demolition.
2. All existing equipment and material removed and not scheduled for reinstallation shall remain the property of the Owner and shall be delivered to a designated stockpile area on the site by the Contractor. Materials not wanted by the Owner shall be removed from the site by the Contractor.

D. Asbestos Awareness
1. If suspect asbestos materials are encountered, the contractor shall cease work in that area and inform the owner of his suspicions and will not proceed with work until such time that a determination can be made on how to proceed.

E. Site Investigation
1. Before submitting his proposal, the Contractor should examine the site and building(s) as it pertains to this Project and make allowances in his proposal for all conditions that will affect the work indicated in the Project manual and contract documents. This would include hidden and other discovered obstacles such as existing pipes, ducts and equipment not necessarily shown on the project drawings.
2. Building access may be arranged by contacting the Owner.

1.18 SUBMITTALS AND BROCHURES OF EQUIPMENT (O&M MANUALS)

A. The literature required to be submitted and approved in order to fulfill the requirements of this DIVISION falls into two general categories. These are the "Brochures of Equipment" and "Submittals."

B. The "Brochures of Equipment", as the name implies, shall contain all pertinent information for all equipment installed. These books are required to be turned over to the Owner and approved before final payment is authorized. Special training for certain equipment may require the use of this book at an earlier stage of project completion. In these instances, the Contractor will be required to prepare and submit the applicable portions of the Brochures of Equipment significantly before project completion.

C. "Submittals" is a general term for informational literature which must be supplied to and approved by the Contractor prior to installing, receiving, or in some instances, even ordering equipment. The normal required types of submittals include shop drawings, manufacturer's literature, installation and operation instructions (from the manufacturer) and wiring diagrams. System reports, such as start-up reports or balancing reports, and the Project Completion Checklist are two forms of submittals which are required after the equipment has been installed and is operational. Each Section of this Division may contain special or more specific requirements for expanded or additional types of submittal literature. These shall be provided as required by each Section.

D. In general, copies of all returned, approved submittals shall be included in the Brochures of Equipment. These books shall also include complete operation and maintenance literature for each piece of equipment such as may be packaged with the equipment for OEM components. They will be used by the Owner's personnel as the primary source of information for operating and maintaining the installed systems and as such, they shall exhibit a high degree of clarity, thoroughness and be suitably bound and arranged to be useful and durable throughout the life of the installed systems.

E. SUBMITTALS

1. The contractor shall procure manufacturer's literature and/or certified prints for all items of equipment, materials or systems on the job. Shop drawings and literature shall be complete and marked showing name of job, item used, size, dimensions, capacity, rough- in, etc., as required for complete check and installation. Any exceptions of the equipment being furnished from that specified shall be clearly identified. Specific requirements of submittals may be expanded in individual specification sections. Minimum requirements shall include the following:
2. Submit actual installation layout drawings on floor plans showing pipe and duct runs. Provide such drawings for systems such as underground pipe and boiler fluesystems.
3. Manufacturer's literature shall include any and all restrictions on the application and installed service limitations of the product.
4. All shop drawings shall be reviewed, approved and stamped by the Contractor before submittal to the Architect/Engineer.
5. All items of equipment and systems which are to be installed as specified or are not otherwise designated as requiring Owner's or Engineer's approval, will require a letter of compliance by the Contractor stating that these items or system will be provided as specified and will be reviewed and stamped by the contractor.
6. Submittals for any piece of equipment or system which is a substitute from that specified or of any equipment or system specifically directing Engineer's review shall be forwarded to the owner or Engineer (as designated) for review. This submittal shall be made within 30 days of award of contract or specified item shall be furnished. The Contractor shall check submittals for number of copies, adequate identification, correctness and compliance with drawings and specifications and apply his stamp of approval before forwarding the submittal. Submittals shall be revised, changed and/or resubmitted until acceptable and approved by the Owner's representative.
7. Approval of submittals and literature by the owner or Engineer shall not relieve the Contractor from responsibility for deviations from drawings or specifications, nor shall it relieve him from responsibility for errors in shop drawings or other submittal literature.
8. Submit submittals in PDF form for review. Combine all equipment submittal sheets into one file (as file size permits).
9. Copies or scanned documents which are not of a permanent or legible nature will not be accepted for shop drawing submittals. Copies must be legible with all dimensions and other pertinent data clear.

F. BROCHURES OF EQUIPMENT

1. The Contractor shall prepare and submit two complete hard copies and one electronic copy of the Brochures of Equipment. Each shall contain all required submittal data for the construction materials and each piece of equipment (reference Submittal Schedule, 230000 2.2) installed under this project. The literature required for submittal purposes shall be expanded to include operation and maintenance literature for each piece of equipment. Maintenance information shall be complete in every respect and shall include parts lists and assembly drawings wherever applicable. Manuals, catalogs, etc., shall be new, as supplied by the factory, and not photocopied.
2. All literature shall clearly indicate the equipment it represents and shall be labeled with the equipment identification abbreviation found on the drawings, e.g. EF-1, etc. All information which is not applicable to the particular model and size supplied shall be clearly and neatly crossed out with heavy black marker or other suitable means. This includes dimensional drawings, maintenance information, parts lists, wiring diagrams, etc. Only the information applicable to the particular equipment supplied shall remain and it shall be easy to follow. Booklets not meeting these requirements shall be returned for correction.
3. Binders shall be high quality telescoping post type with slide or lever release, metal hinges, and covered hardboard or rigid plastic covers.
4. Dividers shall be used to separate the literature for equipment supplied under each of the various Sections of this DIVISION. Divider headings shall read the same as the Section title e.g. “233400 FANS.”
5. Large size drawings or diagrams shall be folded and placed in heavyweight sheets with pockets.
6. The format of the Brochure shall begin with the submittal requirement list at the front as an index sheet. The dividers for each section shall then progress sequentially and the project completion checklist shall be included at the back as the appendix.
7. Authorization for final payment shall not be made prior to final acceptance of the Brochures of Equipment.

PART 2 PRODUCTS

2.1 BUILDING ATTACHMENTS FOR MECHANICAL WORK SUPPORTS:

A. General Requirements:
   1. Provide building attachments required for supporting mechanical work, suitably selected and installed for the loads applied with a minimum additional safety factor of 3.

   2. Where specified attachments are not suitable for conditions, submit to Engineer for approval, proposal for alternate building attachments.

B. Approved Manufacturers: Anvil, or equivalent products by Michigan Hanger and B-Line.

C. Provide supplemental trapeze supports where necessary. Design trapeze to support all trades. Coordinate loads and supports with all trades. Size trapeze for maximum deflection of 1/64 of the span.

D. Attachments to Structural Steel:
   1. Support mechanical work from building structural steel where possible and approved. No welding or bolting to structural steel is permitted unless authorized by Architect. C-clamps are not permitted.
   2. Center beam clamp - for loads over 120 lb.: Malleable center hung Anvil Fig. 228.
   3. Side beam clamp with retaining clips - for loads up to 120 lb.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Install equipment and materials in accordance with manufacturer’s written and illustrated instructions, as detailed on drawings and as described in these specifications. Bring discrepancies in installation methods to the attention of the owner and A/E.

B. Install hanger rod straight, without bending.

3.2 COMPLETION AND TESTS

A. The contractor shall inform the engineer of progress throughout construction as necessary to complete inspections. Inspections shall include rough-in, substantial completion and final completion.

B. The rough-in inspection shall be completed prior to sheetrock or ceiling installation.

C. The substantial completion inspection shall be performed after all work has been completed and systems are operating correctly. During the substantial completion inspection, a functional system test shall be performed by the installer(s) in the presence of the Engineer and owner's designated representatives. During the test the contractor shall demonstrate that all systems and equipment perform in the manner described in the specifications and indicated on the drawings. Any systems found not to be operating properly shall be repaired and followed up with an additional functional system test. After substantial completion a list of mechanical construction deficiencies (punch list) shall be prepared and sent to the mechanical contractor.

D. The engineer's final inspection shall be completed after the mechanical contractor has completed or repaired all items listed in the construction deficiencies list. The contractor shall not request final inspection until the deficiencies list has been fully completed.

End of section 230000

SECTION 233207 – DUCTWORK AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Ductwork materials, plenums, construction, fabrication, and support
   2. Galvanized steel ductwork.
   3. Round and flat oval ductwork.
   4. Reinforcing and supports.
   5. Flexible duct.
   6. Round or Oval Acoustical Duct
   7. Duct sealants.
   8. Duct Accessories
   9. Grilles, Registers, Diffusers
   10. Duct cleaning and disinfecting
   11. Ductwork sealing, inspection, and leakage testing.

1.3 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.
B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the following quality assurance standards; latest editions, unless noted otherwise.
C. ASTM A653 / A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc- Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
D. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, And Flat Bar.
E. ASTM B 209 & 209M – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
F. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
G. NFPA 90B – Standard for the Installation Of Warm Air Heating and Air Conditioning Systems.
H. NFPA 91 – Standard for Exhaust Systems for Conveying of Materials.
I. NFPA 92A – Standard for Smoke Control Systems.
J. NFPA 92B – Standard for Smoke Management Systems.
K. NFPA 96 – Standard for Ventilation Control of Cooking Operations.
L. NFPA 99 – Standard for Health Care Facilities.
M. SMACNA – All standards.
N. AWS - All applicable standards.
O. UL 181, 181A, & B – Factory-made Air Ducts and Connectors and Closure Systems.
P. UL 760 – Standard for Exhaust Hoods For Commercial Cooking Equipment.
Q. UL 723 – Standard for Surface Burning Characteristics of Building Materials.
R. National Air Duct Cleaners Association (NADCA).

1.4 SUBMITTALS

A. Provide the following information and product data:
   1. None required.

1.5 WARRANTY

A. Provide a complete parts and labor warranty for a minimum of one year from the date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL

A. Provided duct and fittings of G90 galvanized steel unless otherwise indicated.

B. Constructed duct and fittings in compliance with SMACNA standards and recommendations and per the additional requirements indicated.

C. Duct dimensions indicated on drawings are inside dimensions. The sheet metal dimensions shall be increased an equivalent amount to accommodate internal liner where liner is required.

D. Drawings are diagrammatic and indicate the arrangement of the principal apparatus, ductwork, and piping, and shall be followed as closely as possible. All the required offsets, rises, drops, fittings and accessories are not indicated on the drawings, but shall be provided as required for a complete system. Carefully investigate structure, finish conditions, and the work of other sections affecting sheet metal work, including work associated with testing, adjusting and balancing, in order to arrange all items accordingly. Provide best possible arrangement to provide maximum headroom and maintenance clearances.

E. In addition to sheet metal ductwork specified herein, provide, or install as furnished by other sections, accessories and devices including, but not limited to, smoke detectors, plenums, canopy hoods, control dampers, and blank-off panels at unused louver areas.

F. Alternate Joining Methods: As an alternate to SMACNA joining methods, Contractor may propose proprietary joining systems with performance equivalent to SMACNA for Owner's approval.

G. Refer to Drawings for ductwork construction and application schedule.

2.2 DUCTWORK MATERIALS AND FABRICATION

A. General Ductwork Fabrication Requirements:

1. Provide fittings, branches, inlets and outlets in such a manner that air turbulence is reduced to a minimum.
2. Turns:
   a. Use radius type elbows wherever possible. Where it is not possible to install a 1.5 times width to centerline radius elbow (full radius elbow), use lesser radii configurations, with 'radius-proportional' splitter vanes permanently installed within. No radius shall be less than 1.0 times width. Provide square elbows of equivalent pressure drop in rectangular ducts where radius elbows will not fit or where specifically noted on drawings. Elbows shall be installed with vanes in accordance with Related Section "Sheet Metal Accessories." Stamped elbows may be used up to and including a diameter of 12 in.
3. Transitions:
   a. Limit transition angles (for each side) to 15 degrees diverging and 30 degrees converging.

B. Galvanized Steel Ductwork:

1. Minimum steel rectangular duct gage shall be as follows:
   a. Ducts through 12 in. wide: 24 Gage
   b. Ducts 13 in. through 30 in. wide: 22 Gage.
   c. Ducts 31 in. through 84 in. wide: 20 Gage.
   d. Ducts 84 in. and larger: 18 Gage
2. ASTM A653, A924 mill galvanized steel sheet, 1.25 oz per sq. ft. zinc coating on each side in conformance with coating designation G-90.

C. Galvanized Touch-Up Paint: Inorganic zinc-rich touch up paint containing a minimum of65

2.3 DUCT SEALANTS

A. Solvent-based sealants may only be used if the outdoor air temperature will be below 40˚F within 24 hours of applying.

B. Sealant shall be non-asbestos type, and comply with UL and NFPA 90A.

C. Sealant: Water or solvent based elastomeric compound, gun or brush grade, maximum 25 flame spread and 50 smoke developed (dry state) specifically for sealing ductwork. Use products as recommended by manufacturer for low, medium or high-pressure systems.

1. Manufacturers
   a. Hardcast.
   b. McGill Airflow LLC.
   c. Polymer Adhesives.

d. Ductmate.

D. Tape shall not be used.

E. Gaskets and mastics used for flanged joints shall be compatible for the service of use and per the manufacturer's recommendations.

2.4 DUCT ACCESSORIES

A. Equivalent products of Elgen, Young, Duro-Dyne, Cesco or Ventfabrics are acceptable.

B. Duct turning vanes - single vane with trailing edge as per SMACNA Fig. 2-3.

C. Flexible connections - Ventfabric's Ventglas or as approved. Fabric width necessary to provide 4" metal-to-metal separation.

2.5 DUCTWORK CLEANING AND DISINFECTING

A. When scheduled, the minimum requirements for commercial HVAC system cleaning shall be as described in the National Air Duct Cleaners Association (NADCA) "General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems."

PART 3 EXECUTION

3.1 GENERAL SHEET METAL INSTALLATION

A. Ductwork shall be installed to true alignment, parallel or perpendicular to adjacent building walls, floors and ceilings, to present a neat and workmanlike appearance.

B. Provide necessary offsets and transitions to avoid interference with the building construction, piping, or equipment. Locate ducts with sufficient space around equipment to allow operating and maintenance activities.

C. Bullhead tees and straight tap connections are not acceptable.

D. Provide straight runs of ductwork, upstream and downstream, at equipment, fans, coils, TAU's, LTAUs, and humidifiers per manufacturer's recommendations and as indicated on drawings.

E. Provide flexible connector where ductwork connects to fans, air handling units and other rotating equipment and where indicated on drawings, with at least 4" metal-to-metal. Flexible connec- tions shall be airtight.

F. Repair damaged galvanized surfaces with zinc rich paint.

G. For ductwork mounted outdoors, install duct with slight lateral pitch to prevent water ponding on top of duct.

H. Enclose dampers located behind architectural intake or exhaust louvers in a sheet metal collar and seal to building construction.

I. All dampers shall operate smoothly through their entire range. Provide locking mechanisms to secure volume dampers in position.

J. Air volume control on parallel flow branches shall be accomplished with branch dampers; splitter type dampers are not acceptable.

K. Install special equipment items in ductwork systems including, but not limited to: control dampers, thermometers, airflow measuring devices and other related items, according to manufacturer's recommendations.

L. Wall and Floor Penetrations

1. Provide sheet metal sleeves in all concrete or masonry walls and floors. Frame or sleeve openings through stud walls.
2. Sleeves and openings sized to accept the duct with insulation. Pack insulation in after duct is installed.
3. Grout sleeves in place in existing masonry walls or floors.
4. Provide finishing collars on each side of wall or floors at all penetrations.
5. Seal the space between ductwork and sleeves with mildew resistant silicone caulk.

3.2 DUCTWORK HANGERS AND SUPPORTS

A. Generally, hang and support ductwork per the latest edition of SMACNA. Additionally, adhere to the more specific requirements found in this specification section, the Related Sections, and as indicated on the project drawings.

B. Hanging duct, equipment, or accessories with cables or wires is prohibited.

C. Comply with Related Sections and drawing details regarding hangers, building attachments, fasteners, beam clamps and retaining clips, and as note below.

D. Provide vibration isolation as specified in Related Section.

E. Ductwork shall be supported and anchored to structure so that horizontal ducts are without sag or sway, vertical ducts without buckle and all ducts are free from deformation, collapse or vibration

F. Support un-insulated rectangular ducts in sizes to 36 in. by non-perforated galvanized steel strap or by trapeze hangers. Support insulated rectangular ducts and ducts larger than 36 in. with trapeze hangers.

G. Provide at least one support for each length of duct, with a maximum hanger spacing of 10 feet. Install supports on both ends of duct turns, branch fittings and transitions.

H. Do not hang ductwork from piping, ducts, other trades hangers, existing hangers, or equipment.
I. Single band hangers are not acceptable on ducts greater than 24 in. diameter.
J. Provide supports on each side of any duct mounted equipment or device, including fans, coils, dampers, etc, to permit removal of item without removal of adjacent duct sections.
K. Provide supplemental steel required to support ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned.
L. Beam clamps shall be double sided on ducts over 36 in. by 36 in. Use double sided or single sided beam clamps with retaining clips on all other sizes.
M. Provide clamping systems that are compatible with the structural steel system of the building.
N. Use angle iron "V" construction supports or similarly rigid construction for vertical ducting that requires lateral support.
O. Ductwork mounted on roof or otherwise exposed to elements shall be supported with frames constructed of galvanized steel angles and channels, regardless of duct size. Supports shall not rest on top of roof, but shall be firmly attached to roof structure and properly flashed. Ducts that penetrate through the roof shall utilize curbs and shall be counterflashed. All fasteners shall be galvanized.
P. Provide angle sway bracing and diagonal cross bracing to the structure to provide support against maximum lateral loads that may be imposed on the ductwork installed downstream of fan discharges and ductwork exposed to wind loads, and any other locations exposed to lateral loads.

3.3 DUCTWORK CLEANING

A. All equipment, plenums, ducts, grilles and registers, hoods and component parts of all duct systems shall be clean and free of dirt and debris on both the inside and outside of all components. Cleaning methods shall consist of sweeping, vacuuming, washing, etc., as necessary to establish clean conditions.

END OF SECTION 233207

DIVISION 26 ELECTRICAL

SECTION 260000 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections apply to this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor and services necessary to furnish, install, test and turn over to the Owner the following electrical work as required by these specifications and as shown on the drawings, including all shop drawings, test reports, record drawings, operations and maintenance manuals, Owner training and incidental items necessary to complete the project in every respect.

B. Participate in project coordination, scheduling and commissioning activities as specified in Division 01.

1.3 REFERENCES

A. Provide equipment and materials that conform to the applicable standards of the following organizations:
   1. American National Standards Institute (ANSI).
   2. Institute of Electrical and Electronic Engineers (IEEE).
   3. National Electrical Manufacturers Association (NEMA).
   4. National Fire Protection Association (NFPA).

B. All materials and equipment shall be listed and labeled by Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), MET Laboratories (MET), or the Canadian Standards Association (CSA).

C. Install equipment and materials in compliance with the following:
   1. National Electrical Code (NEC).
   2. Life Safety Code (NFPA-101).
   3. Uniform Federal Accessibility Standards (UFAS).
   4. Owner's Inspection Authorities.
   5. Manufacturers' instructions.

1.4 DESIGN DOCUMENTS

A. Contact the Owner's Representative about design questions and discrepancies between design documents before performing the work.

B. Notify the Owner's Representative if existing code violations are uncovered that are not addressed in the design documents prior to commencement of work.

1.5 SUBMITTALS

A. Submit for approval copies of shop drawings and product literature for the following equipment. Submittals shall include adequate information to prove that the systems, equipment and materials comply with the contract documents. Each copy of the submittals shall be marked to indicate the specific models, sizes, types and options being provided. Submittals not so marked will be rejected.

   1. Disconnect and Safety Switches.
   2. Wiring Devices.
   3. Lighting Fixtures.
   4. Lighting Control Systems, Dimmer Systems and Switches.
   5. Conduits and Fittings.
   6. Cables, Wires and Terminations.

1.6 RECORD DOCUMENTS

A. Submit redlined as-built drawings to design engineer. Show the locations of equipment, light fixtures, switches, receptacles and junction boxes, riser information, the sizes of conduits and conductors, circuit numbers, and deviations from the design. Dimension the locations of buried, embedded and concealed primary and feeder conduits from permanent building features.

1.7 OPERATIONS AND MAINTENANCE MANUALS

A. Submit for approval copies of operations and maintenance manuals as specified in Division 01 and the other Division 26 sections.

B. Contactor shall provide an electronic copy of all information. Manuals shall be indexed by spec section and marked to indicate the specific models, sizes, types and options of the systems and equipment that were provided. Equipment and materials that were not part of the project shall not be included in the manuals. Manuals not so marked will be rejected.

1.8 QUALITY ASSURANCE

A. Electrical work shall be performed by licensed Journeyman or registered Apprentice Electricians. The number of Apprentices on a project shall not exceed the number of Journeymen. Electricians shall carry a copy of their license or registration while working on site.

B. Contact the engineer of record at the milestones indicated during the project to arrange for periodic inspections. If the project has phased construction the noted inspections shall apply to each phase.

1. Rough In; After the completion of framing and after completion of the panels, boxes and conduit installation, prior to sheetrock.
2. Substantial completion; After completion of electrical when systems are energized and operational.

1.9 COMPLETION AND TESTS

A. Complete and test each system and leave in proper operation. Leave all systems in proper operation.

B. At the time of finalizing the Project, a completion system test shall be performed in the presence of the Owner's designated representatives. During the test the contractor shall demonstrate that all systems perform in the manner described in the specifications and indicated on the drawings. Tests shall be repeated after any corrections are made as a result of initial testing of correctional work under guaranteed provisions.

1.10 OWNERS TRAINING/INSTRUCTION

A. The Contractor shall provide qualified personnel to instruct the Owner's maintenance people in the operation and maintenance of all new equipment. The training session shall be done at the owner’s convenience, after all systems are fully complete and operational.

B. The owners training shall include a review of the operation and maintenance manuals.

1.11 REMODELING WORK

A. Whenever existing wire, conduit, controls, circuits, etc. are cut into, removed or interrupted, as a result of the contract work, all such items that serve areas or equipment that remain shall be replaced, rerouted, extended, relocated, etc. as necessary to maintain operation of equipment and services.

B. Downtime shall be held to a minimum. Outages shall be scheduled at a time acceptable to and approved by the Owner. Consult with in sufficient time for him to make necessary preparations for the outage.

D. Asbestos Awareness

1. If suspect asbestos materials are encountered, the contractor shall cease work in that area and inform the owner of his suspicions and will not proceed with work until such time that a determination can be made on how to proceed.

E. Site Investigation

1. The Contractor shall be cognizant that this is a remodeling project and as such, certain items cannot be fully illustrated nor explained without field observation. Before submitting his proposal, the Contractor should examine the site and building as it pertains to this Project and make allowances in this proposal for all conditions that will affect the work indicated in the project manual and contract documents. This would include hidden and other discovered obstacles such as existing pipes, ducts, and equipment not necessarily shown on the project drawings.

F. Building access may be arranged by contacting the Owner.

1.12 WARRANTY

A. Guarantee work for a period of one year from the date of the Owner's final acceptance of the project (Substantial Completion). A manufacturer’s warranty beginning upon equipment receipt or startup shall be extended to one year from final project acceptance. A manufacturer’s warranty in excess of one year shall remain in effect for its entire time period.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SUBSTITUTIONS

A. Provide equipment and materials from the manufacturers specified. Substitutions for specified products are acceptable only if proposed and approved in writing at the time of bid.

3.2 TEMPORARY SERVICE

A. Provide, maintain and remove all temporary lighting and power required to complete the project.
B. Provide ground fault protection on temporary feeders rated 200 amps and larger.
C. Temporary feeders shall be limited to the following types:
   1. Conductors installed in raceways.
   2. NEC Type MC cable.
   3. Multi-conductor cable with an overall outer jacket (where inaccessible to the public and not subject to damage or abuse).
   4. NEC recognized hard usage cord or extra hard usage cord (where inaccessible to the public and not subject to damage or abuse).
D. Install and support temporary wiring in accordance with the NEC requirements for permanent wiring.
E. Label temporary power feeders every 25 feet maximum.
F. Temporary wiring may either be copper or aluminum.

3.3 ELECTRICAL COORDINATION

A. Coordinate power interruptions with the other disciplines in accordance with Division 01. Notify the Owner's Representative of power interruptions 3 working days in advance. Maintain power to all loads outside of the work area.

3.4 DEMOLITION

A. Protect adjacent building services and materials indicated to remain. Install and maintain barriers to keep dirt, dust and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition is completed.
B. Remove all equipment and materials designated for demolition as follows:
   1. Power wiring - remove back to the source or to the first junction box where the circuit continues on to remaining loads.
   2. Telecommunications wiring - remove back to the telecommunications room.
   3. Conduits and boxes in walls and above permanent ceilings - abandon in place. Install blank cover plates on boxes.
   4. Conduits through floors and walls, and boxes in floors - remove completely. Patch and paint penetrations to match existing.
   5. Exposed and accessible conduits, wireways and boxes - remove completely. Patch and paint surfaces to match existing and plug unused panel and junction box holes.
   6. Lighting fixtures and electrical equipment - remove and dispose of completely (unless designated for relocation).

3.5 RELOCATION

A. Carefully remove, clean and restore items designated for relocation to a "like new" condition, and store them for reuse.

3.6 SALVAGE

A. Equipment and materials removed during demolition, unless noted otherwise, shall become the property of the contractor with due consideration for all such removed equipment included in the bid price.

3.7 CLEANUP

A. Remove and legally dispose of demolished items, rubbish and debris from the construction site daily, and at the completion of the work. Failure to do so may result in the cleanup being performed by others and all costs thereof being deducted from the Contractor's final payment.

3.8 EQUIPMENT PROTECTION

A. Protect equipment and materials during shipment, storage and construction against damage and contamination.

B. Items that become damaged or contaminated shall be restored to a "like new" condition or replaced at the Contractor's expense.

3.9 WORK PERFORMANCE

A. Locate equipment as close as practical to the locations shown on the drawings. Should field conditions prevent the installation of equipment or materials as indicated on the drawings, make any deviations only with the prior approval of the Owner's Representative.

B. Install and connect new work to existing work neatly and carefully. Existing work that is disturbed shall be repaired or replaced as necessary to restore it to its prior condition.

C. Coordinate work with the other trades to ensure completion consistent with the project schedule. Do not unduly delay the startup, testing or turnover of project systems.

D. Coordinate work with the other trades to ensure a safe working space around electrical equipment and to ensure access to equipment requiring maintenance (including motors, controls, panels, lighting, valves, filters, and VAV boxes). Working space and access shall be sufficient for an adult to perform maintenance tasks safely without straddling or removing obstructions. Electrical work that encroaches on working space or that impedes maintenance shall be relocated at the Contractor's expense.

E. Coordinate work with the other trades to provide access doors to maintainable electrical equipment (including lighting fixture remote ballasts) located behind walls or above permanent ceilings.

F. Prior to core drilling concrete floors, test for the presence of electrical conduits. Use an impulse induction type scanner capable of detecting both metallic conduits and copper wires in PVC conduits.

3.10 FIELD QUALITY CONTROL

A. Arrange for testing and commissioning of electrical systems, equipment and materials prior to final acceptance of the work. Acceptance tests and commissioning shall be performed in accordance with the Related Sections listed above, and applicable codes, standards and manufacturers' instructions.

B. Provide all test equipment, materials and labor necessary to perform the tests, and coordinate with the other trades for necessary services, such as scaffolding and the uncoupling of motors.

C. Replace any equipment or materials found to be defective or found to be of lesser quality than that specified or shown on the drawings.

D. Provide written test reports, signed and dated, for all tests prior to acceptance of the electrical equipment by the Owner.

E. Provide the training specified in each specification section.

END OF SECTION 260500

SECTION 260513 - CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections apply to this Section.

PART 2 - PRODUCTS

2.1 CABLE AND WIRE (600 VOLTS AND BELOW)

A. Secondary distribution and power cable shall be single conductor stranded copper, No. 12 AWG minimum; with NEC Type THHN insulation rated 90 degrees C, 600 volts. Alan Wire, American Insulated Wire, General, Cerro Wire, Encore, Republic Wire, Rockbestos, Service Wire, or United Copper Industries.

B. Lighting wire for above ground use shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type THHN insulation rated 90 degrees C, 600 volts. Alan Wire, American Insulated Wire, General, Cerro Wire, Encore, Republic Wire, Rockbestos, Service Wire, or United Copper Industries.

C. Lighting wire for underground use in conduit shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type XHHW insulation rated 90 degrees C in dry locations and 75 degrees C in wet locations, 600 volts. American Insulated Wire, General, Cerro Wire, Encore, Republic Wire, Rockbestos, Service Wire, or United Copper Industries.

D. Control cable shall be single conductor stranded copper No. 14 AWG minimum; with NEC Type THHN insulation rated 90 degrees C, 600 volts.

E. Instrumentation and special systems wire shall be in accordance with manufacturers' recommendations but shall not be less than 20 AWG.

F. Type MC cable shall be made up of individual conductors as noted above, be color coded, include a separate ground conductor, and shall have a corrugated metal armor over its entire length.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Install all cables and wires in raceways unless otherwise indicated.

1. Raceways for telecommunications and low voltage control systems may be omitted above ceilings when installed within accessible lay-in ceilings and j- hooks or cable trays are provided.
    a. Telecommunications raceways shall be continuous from outlet boxes to telecommunications rooms or cable trays.

B. Use cable lubricant when pulling primary cables and secondary feeder cables. Avoid exceeding manufacturer's recommendations on pulling tensions; sidewall pressures and cable bend radii.

C. Splice power cables with solderless compression butt splices or ring lugs. Terminate power cables including motor leads with solderless compression ring lugs. Splice branch circuit wiring, lighting wiring, and control and instrumentation wiring with wire nut connectors. Terminate control and instrumentation wiring with solderless compression ring or spade lugs. Compression connectors and lugs shall be crimped with tools specifically designed for the terminations being crimped.

D. Provide identification tags on all cables and conductors terminated in panels.

3.2 FIELD QUALITY CONTROL

A. Perform testing in accordance with Section 260800 and submit test reports.

END OF SECTION 260513

SECTION 260533 - ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections, apply to this Section.

1.2 SUMMARY

A. Provide conduits, cable trays, surface raceways, boxes, fittings and supports to form a complete, coordinated, and continuously grounded raceway system.

1.3 CONDUIT REQUIREMENTS

A. Conduits indoors in general areas shall be electrical metallic tubing (EMT) with steel set screw fittings.

B. Conduits indoors in hazardous areas, encased in concrete floor slabs or subjected to water, physical damage or abuse shall be galvanized rigid steel (RS) or intermediate metal conduit (IMC) with cast or malleable iron threaded fittings and bushings.

C. Conduits indoors for primary power distribution circuits or for fire pump feeders shall be galvanized rigid steel or intermediate metal conduit with cast or malleable iron threaded fittings and bushings. Where the conduits are routed through the building, they shall be encased in 2 inches of concrete.

D. Conduits outdoors shall be galvanized rigid steel or intermediate metal conduit with cast or malleable iron threaded fittings and bushings.

E. Conduits encased in concrete underground shall be Type DB PVC with matching fittings.

F. Conduits direct buried underground shall be Schedule 40 PVC with matching fittings.

G. Conduits in parking structures, steam tunnels and near or in cooling towers shall be fiberglass-reinforced epoxy, or Schedule 80 PVC, with matching fittings. Exceptions to this requirement are tunnel segments inside building (i.e., mechanical rooms), or in heated rooms of parking structures. In these cases EMT may be used

H. Final connections to recessed lighting fixtures and under-counter lights shall be 1/2" minimum flexible metallic conduit, manufactured wiring systems, or galvanized steel Type MC cable, all with steel fittings.
   1. Manufactured wiring systems shall
      a. Only be used above accessible ceilings.
      b. Shall not be used in walls or above permanent ceilings.
      c. Shall contain a dedicated, separate, grounding conductor
   2. Type MC cable conductors shall be color coded to match the building color- coding scheme. Type MC cable shall be terminated with steel setscrew connectors that have integral insulating bushings. Self-locking, twist-in type fittings are not acceptable.

I. Final connections to motors, transformers and equipment subject to vibration or removal for maintenance shall be 1/2" minimum liquid tight flexible metallic conduit with steel liquid tight fittings. Transformer connections may be non-liquid tight flexible metallic conduit in electrical rooms only.

J. Connections to recessed power receptacles, and light switches, in areas with accessible ceilings:
   1. In new 'metal stud and gypsum board partitions (walls)', the final connections may be made with type MC cable. This MC cable, shall:
      a. Be run to a box immediately above the accessible ceiling, and the box size shall not exceed 4-11/16" square.
      b. Conduit shall be used for the entire run, from this junction box, to the power source, load (lights), etc.
      c. No more than three circuits may be run through any given junction box.
      d. Individual conductors making up the MC cable shall be stranded copper, with separate grounding conductor, and steel corrugated armor. Individual conductors shall be color coded as required in section 260513.
      e. The MC cable is terminated using UL listed hardware intended for the cable and boxes being used, (and rated for commercial and industrial environments).
      f. The MC cable shall be secured in the wall cavity as required by NEC
      g. The MC cable shall be as short as it is necessary to serve the need and meet the Code

2. In existing 'metal stud and gypsum board partitions (walls)', where the wall is not being otherwise opened up, the final connections to new devices may be made flexible conduit and standard (separate) conductors. This flexible conduit shall:
   a. Be increased in size as necessary to maintain the proper fill for the wiring to be installed.
   b. Shall be installed and secured as required by NEC.
   c. Shall be as short as it is necessary to serve the need and meet the NEC.
3. In all other wall types and conditions use standard conduit, of the type appropriate for the wall construction.

K. Connections to other recessed devices, (including communication outlet boxes, junction or pull boxes, etc) shall be with standard conduit of the type appropriate for the wall construction.

1.4 SURFACE RACEWAY REQUIREMENTS

A. When conduits in finished areas cannot be concealed in walls or above ceilings, surface raceways may be used where permitted. Boxes and fittings shall match and be from the same manufacturer as the raceways.

1.5 BOX REQUIREMENTS

A. Provide sheet steel outlet boxes, extensions, and plaster rings for EMT, flexible metal conduit, and MC cable.

B. Provide cast or malleable iron outlet boxes and covers for galvanized rigid steel conduits, intermediate metal conduits, and liquid tight flexible metal conduits.

C. Boxes shall be sized for all conductors and devices to be contained within. Box extensions shall not be used to correct for undersized boxes. A single extension may be used as follows only if all free conductors extend at least 3 inches outside of the extension opening.
   1. On boxes being flush mounted in masonry walls.
   2. On existing boxes in walls that are being furred out.
   3. On existing boxes for connecting to an existing circuit.
   4. On fire alarm, security and clock system boxes where required by the system manufacturer's instructions.

D. Plaster rings shall not be considered box extensions, but their capacities may be included in box fill calculations.

1.6 SUPPORT REQUIREMENTS

A. Surface mounted equipment shall be secured to steel channels. The channels shall be attached with toggle bolts to hollow tile, block or similar surfaces, and attached with screws or bolts and expansion shields to solid masonry or concrete.

PART 2 - PRODUCTS

2.1 CONDUITS

A. Electrical metallic tubing shall be thin wall steel tubing, electro-galvanized or hot dipped galvanized inside and outside. Fittings and bushings shall be galvanized steel set screw type with two screws per connection for sizes over 2".

B. Galvanized rigid steel conduit and intermediate metal conduit shall be hot dipped galvanized inside and outside, in 10' lengths and threaded on both ends. Fittings and bushings shall be cast or malleable iron, and hot dipped galvanized inside and outside.

C. PVC conduit and fittings shall be Type DB for encasement in concrete, Schedule 40 for direct burial, concealed and exposed work, and schedule 80 in parking structures. Fittings shall be of the same type and from the same manufacturer as the conduit. PVC conduit shall be UL Labeled for 90 degrees C cables. Cantex, Carlon or National Pipe & Plastic.

D. Fiberglass reinforced epoxy conduit shall be standard wall, iron pipe size, sunlight resistant, gray color, with matching push-fit fittings. FRE or Champion.

E. Flexible metallic conduit shall be galvanized steel or aluminum. Fittings shall be of steel with cadmium or galvanized finish. Fittings shall be machine screw clamp type, single or two-piece. Self-locking, twist-in type fittings are not acceptable.

F. Liquid tight flexible metallic conduit shall consist of a flexible, galvanized steel core, a continuous copper ground strip and a polyvinyl chloride jacket. Fittings shall be steel liquid tight grounding type from the same manufacturer as the conduit.

2.2 SURFACE RACEWAYS

A. Where surface raceways are called for on the drawings, or when conduits in finished areas cannot be concealed in walls or above ceilings, surface raceways shall be used. Boxes and fittings shall match and be from the same manufacturer as the surface raceway.

B. Surface raceways shall consist of a base and cover, sized for the number of conductors contained within, complete with all connectors, fittings, bushings, boxes, covers and mounting hardware.

C. Raceways shall be 600 volts rated, and be in compliance with the applicable paragraphs of NEC Article 352.

D. They shall be non-flammable, and UL labeled, under UL 5, or UL 5A (as applicable).

E. The completed raceway system shall be vandal resistant.

F. Shall accept receptacles, cover plates, telephone/data outlets and other standard wiring devices as specified elsewhere in these specifications.

G. The cover plates used for wiring devices and telecommunication outlets shall be of the 'overlapping' type and shall therefore cover the 'cut-end' of the raceway cover.

H. The raceways shall have a select ivory (or white, or gray where noted) color, "scuff" resistant finish, and the raceways shall be paintable.

I. All components of the raceway system exposed to view shall be of the same color and shade.

J. Barriers shall be provided when necessary to separate conductors of different voltages, or services.

K. Surface raceways shall be steel or plastic as noted below, and as noted on the drawings:

1. Metallic
   a. Metallic raceways shall be of .040" thick (minimum) zinc plated or galvanized steel.
   b. The acceptable levels of quality are, generically,
      1) "Wiremold V500 and V700" for smaller single channel raceway applications,
      2) "Wiremold V3000" for larger single channel raceway applications, and
      3) "Wiremold V4000" for larger multi-channel raceway applications.
   c. Manufacturers include Hubbell, Wiremold, Thomas and Betts, or Mono- System.
2. Plastic
   a. Plastic raceways shall be of a material meeting all of the requirements of UL 5A, (including flammability, resistively structural strength, etc.).
   b. The acceptable levels of quality are generically:
      1) Panduit series LDS5 and LDS7, Carlon Series 30 or Wiremold Series PN05 or PN10 for raceway applications when surface raceway replaces conduit in finished areas.
      2) Panduit LD series, Carlon series 30 or Wiremold Series PN05 for smaller single channel raceway applications.
      3) Panduit Type T-70, Carlon “Premiere” or Wiremold Type 40N2 for larger single or multi-channel raceway applications.
      4) Panduit Twin 70, Carlon "Prestige" or Wiremold Type 60N2, for larger multi-channel raceway applications.
   c. Manufacturers include Panduit, Carlon, Hubbell, Mono Systems, and Wiremold.

L. Use vertical surface raceways from junction boxes above the ceiling, to the horizontal portion of the surface raceway. Locate vertical section as close to room corners (or 'vertical breaks' in mid wall) as is possible. Use of exposed vertical conduits is not acceptable.

2.3 BOXES

A. Boxes for fixtures, outlets, switches, equipment connections and wire pulling shall be
   1. Cast or formed from carbon steel sheets of commercial grade steel not less than 14-gauge,
   2. One-piece construction, zinc, or cadmium plated,
   3. Tapped for mounting plates and covers as required.

B. Pull and junction boxes shall be
   1. Fabricated from galvanized or painted code gauge cold rolled carbon steel sheets.
   2. Welded construction with flat removable covers fastened to the box with machine screws.
   3. Seams and joints shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by continuous welding which will provide equivalent strength to flange construction.
   4. Preferably not provided with 'knockouts'.

C. Box covers shall be fastened in place by machine screws or hinges and latches. Self- tapping or sheet metal fasteners are not acceptable.

2.4 SUPPORTS

A. Hangers and brackets shall be made of steel pipe, channel iron, angle iron or prefabricated steel channel. Prefabricated steel channel shall be by B-Line, Hilti, Powerstrut or Unistrut.

B. Anchors shall be lead shield anchors or plastic expansion anchors for small loads, and expansion or epoxy anchors for large loads. Powder-driven anchors shall not be used.

2.5 LABELS AND DIRECTORIES

A. Equipment nameplates shall be engraved .125 inch (1/8") thick laminated plastic, white, with black letters. The engraved letters shall be at least one quarter inch (¼")high.

B. Receptacles and lighting switches shall be labeled using clear adhesive backed nylon or Mylar tape with black text permanently laminated to the tape.

C. Panel directories shall be typed on supplied card stock with panel, or card stock similar in thickness and material as those supplied with the panels. Install supplied clear plastic cover, or one of like material.

PART 3 - EXECUTION

3.1 RACEWAYS

A. Size conduits in accordance with the NEC, but not less than the sizes shown on the drawings. Minimum power and control conduit size shall be 1/2". Minimum telecommunications conduit size shall be 3/4"".

B. Install concealed and exposed conduits and cable trays parallel to or at right angles to building lines. Conduits shall not be embedded in concrete slabs except where specifically shown. Install surface raceways as close to room corners or trim features as possible to make the surface raceways less obvious. Where conduits are routed over beams and under corrugated decking, conduits shall be offset 3” below the decking to avoid damage from future decking penetrations.

C. Make directional changes in primary power distribution conduits above ground with sweeps and long radius elbows, and underground with 20' minimum radius bends.

D. Conceal conduits wherever possible and practical. When conduits cannot be concealed in finished areas, use surface raceways with matching boxes from the same manufacturer as the raceways.

E. Metal conduits, fittings, enclosures and raceways shall be mechanically joined together in a firm assembly to form a continuous electrical conductor providing effective electrical grounding continuity.

F. Provide expansion fittings at the intervals specified in the manufacturer's instructions.

G. Conduits entering panels located outdoors, in parking structures, in steam tunnels and on cooling towers shall enter from the sides, back, or bottom. Conduits shall not enter from the top.

H. Separate raceways from uninsulated steam pipes, hot water pipes, and other hot surfaces by a minimum of 4” horizontally or 12” vertically. Separate raceways from ventilation ducts and insulated pipes so that they do not come into contact with each other.

I. Low voltage signal circuits shall be separated or shielded from power circuits to prevent the induction of noise into the signal circuits.

J. EMT entering sheet metal enclosures and outlet boxes shall be secured in place by a connector with a locknut. Rigid conduit shall be secured with locknut inside and outside and a bushing. Sufficient thread on the connector or conduit shall extend into the enclosure so that the bushing will butt tight into the connector or conduit. Bushings shall not be used as jamb nuts or in lieu of locknuts.

K. Flexible metallic conduit to motors and similar equipment shall not exceed 3'-0" in length, and shall have adequate slack to absorb the maximum vibration. Flexible conduit connections to lighting fixtures shall not exceed 6'-0" in length.

3.2 MOUNTING HEIGHTS

A. Except where shown otherwise, install equipment and devices at the followingheights:

1. Receptacles (Wall): 18" A.F.F. to center
2. Receptacles (Above Counter): 48" A.F.F. to center
3. Receptacles (Unfinished Area): 48" A.F.F. to center
4. Surface Raceway Receptacle Strips: 42" A.F.F. to bottom
5. Light Switches: 48" A.F.F. to center
6. Telephone Outlets (Wall Phone): 54" A.F.F. to center
7. Telephone/Data Outlets: 18" A.F.F. to center
8. Clock Outlets: 88" A.F.F. to center
9. Fire Alarm Pull Stations: 48" A.F.F. to center

10. Fire Alarm Horn/Strobes: 80" A.F.F. to bottom
11. Card Readers: 48" A.F.F. to card slot
12. Security System Controls: 48” A.F.F. to center
13. Thermostats/HVAC Controls: 48” A.F.F. to center
14. Electrical Panels: 72" A.F.F. to top
15. Safety Switches/Motor Starters/Variable Frequency Drives: 72" A.F.F. to top (except top of handle shall not exceed 78" A.F.F.)
16. Motor Control Pushbuttons: 60" A.F.F. to center

3.3 SUPPORTS

A. Provide 4" thick concrete housekeeping pads for floor-mounted equipment.

B. Support all electrical items independently of supports provided by the other trades.

C. Support conduits and boxes using steel conduit straps or 1/4-inch minimum diameter threaded rod hangers. Suspended ceiling hangers or hanger wire shall not be used (except to support flexible metallic conduit and manufactured wiring systems).

D. Support cable trays with support brackets or 3/8" diameter minimum threaded rod hangers at intervals not exceeding 8'-0" for straight runs. Additional supports shall be provided at tray fittings.

E. Hangers shall be of sufficient strength that their deflection at mid span does not exceed 1/240 of the hanger span length after the cables are installed.

F. Route flexible metallic conduit, manufactured wiring systems and Type MC cable parallel to or perpendicular to building lines, and in a neat and workmanlike manner. Coil the excess manufactured wiring systems and Type MC cable, and support independently of the ceiling grid system at intervals not exceeding 3 feet.

3.4 PENETRATIONS, SLEEVES AND FIRE SEALS

A. Cut floor and wall penetrations neatly and to the minimum size required for installation of the equipment and raceways.

B. Provide galvanized steel pipe sleeves for all conduits penetrating floors, exterior walls and roofs.

1. Extend floor sleeves above the floor a minimum of 2 inches.
2. Embed sleeves in new concrete or step-core concrete and grout sleeves into existing concrete with epoxy grout.
3. Seal floor sleeves using fire-sealing systems approved by a Nationally Recognized Testing Laboratory.
4. Seal exterior wall and roof penetrations water tight.

C. Patch both sides of wall penetrations cut for electrical equipment and raceways to seal against the passage of air, sound and fire.

1. Seal cable tray penetrations in fire rated walls using fire sealant bags approved by a Nationally Recognized Testing Laboratory.
2. Seal conduit penetrations in fire rated walls using fire-sealing caulk approved by a Nationally Recognized Testing Laboratory.
3. Seal conduit penetrations in non-rated walls using masonry materials that match the wall construction.
4. Fire seal between recessed outlet boxes located on opposite sides of a fire rated wall if the box openings are over 16 square inches and the boxes are less than 24 inches apart.

3.5 EXPANSION FITTINGS

A. Provide expansion fittings at all building expansion joints. Expansion fittings shall be bonded to the raceway on both sides.

B. Provide expansion fittings, in accordance with manufacture recommendations, in all areas subject to swings in temperature of more than 15 degrees C.

C. Install expansion fittings in all locations were expected expansion difference is ¼", or more, between boxes

3.6 IDENTIFICATION

A. Provide nameplates and labels in accordance with Article 2.6.

1. Laminated plastic labels shall be mechanically secured in place with sheet metal screws and/or bolts and nuts
2. Labels shall be neatly centered. Place labels in like positions on similar equipment.

B. Color code wiring as noted in Section 260513

C. Color code junction boxes and box covers of emergency and fire alarm circuits with red paint. Color code junction boxes and box covers of temperature control circuits with blue paint.

D. Mark junction box covers in indelible ink with the panel and breaker numbers of the circuits contained within.

E. Provide a 3" by 5" yellow "Warning Arc Flash Hazard" label on the outside of panels in 'occupant areas' - Brady Type 99454 or equivalent from another manufacturer. Center the label horizontally and vertically on outside of door.

F. Provide a 4" by 6"'red "Danger Arc Flash and Shock Hazard" label on the outside of panels in areas open only to 'qualified personnel', and on the inside panel door of panels in 'occupant areas' - Brady Type 99459. Center label on gutter areas of distribution panels, centered above or below the directory of panels, and otherwise centered in other applications. In all cases, label will be no lower than 48" or above 84" AFF

END OF SECTION 260533

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All normal power devices to be white unless otherwise indicated.

2.2 TOGGLE SWITCHES

A. Toggle switches shall be rated 120/277 volts, 20-amperes, single-pole, double-pole, 3- way or 4-way as shown, specification grade, extra-heavy duty, back and side wired. Arrow Hart, Bryant, Hubbell, Leviton or Pass & Seymour.

2.3 DIMMER SWITCHES

A. Dimmer switches shall be rated 1000 watts minimum, specification grade, heavy duty, with radio noise filter and suitable for use in a single gang box. Leviton, Lithonia or Lutron.

2.4 OCCUPANCY SENSORS

A. Wall mounted occupancy sensors shall be rated 600 watts minimum, 180 degrees coverage, 300 sq. ft. minimum coverage, infrared type, heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, integral manual override switches, and suitable for mounting in single gang wall mounted boxes. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

B. Ceiling mounted occupancy sensors shall be rated 1000 watts minimum, 180 degrees coverage, 1000 sq. ft. minimum coverage, infrared type, heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, and suitable for mounting in ceiling mounted boxes. Sensors shall utilize low voltage control circuits and be interlocked with the switch circuit for local auto/off control. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

C. Dual technology occupancy sensors shall be rated 1000 watts minimum, 180 degrees coverage, 1000 sq. ft. minimum coverage, and combination ultrasonic/infrared type. The ultrasonic component shall be of a frequency compatible with hearing aids .The overall occupancy sensor shall be heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, and suitable for mounting in ceiling mounted boxes. Sensors shall utilize low voltage control circuits and be interlocked with the switch circuit for local auto/off control. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

2.5 DUPLEX RECEPTACLES

A. Duplex receptacles shall be rated 125 volts, 20 amps, 2-pole, 3-wire, NEMA Type 5- 20R, UL heavy duty, back and side wired, grounding type with nylon or Lexan bodies. Arrow-Hart, Bryant or Hubbell 5362, or Leviton or Pass & Seymour 5362A.

2.6 GFCI DUPLEX RECEPTACLES

A. GFCI duplex receptacles shall be rated 125 volts, 20 amps, 2 pole, 3 wire straight blade type with nylon or Lexan bodies. GFCI receptacles shall trip when ground currents exceed 5 ma, shall trip in 25 milliseconds maximum, and shall have an interrupting rating of 2000 amps. Receptacles shall lock out (off) when the protection system fails. Arrow Hart, Bryant, Hubbell or Leviton.

2.7 TVSS AND CHILD RESISTANT DUPLEX RECEPTACLES

A. TVSS and child resistant duplex receptacles shall be rated 125 volts, 20 amps, 2-pole, 3-wire straight blade type with nylon or Lexan bodies and ivory faces. TVSS receptacles shall clamp at 330 volts or less, and shall have visual indication of the failure of their protective circuitry. Child resistant receptacles shall require the simultaneous insertion of both line and neutral plug blades before power is applied to the receptacle contacts. Arrow Hart, Bryant, Hubbell or Leviton.

2.8 SPECIAL PLUGS AND RECEPTACLES

A. Special receptacles shall be of the voltage, amperage, number of poles, number of wires, configuration, and NEMA Type shown, and specification grade, with nylon or Lexan bodies ivory faces. Arrow-Hart, Bryant, Hubbell, Leviton or Pass & Semour. Provide the required quantity of mating plugs when shown on the drawings.

2.9 'RECEPTACLE STRIPS'

A. Surface mounted receptacle strips shall consist of surface wireways containing receptacles of the types shown. The receptacles shall be spaced and circuited as shown.

2.10 COVER PLATES

A. Except where unique cover plates are required (wall box dimmers, surface raceways, occupancy sensors, etc.), cover plates for switches and receptacles shall be of high-quality Type 302 stainless steel, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Except where necessary to match existing receptacles, install receptacles with their ground slots below, or to the left, of the line and neutral slots.

B. Provide No. 10 AWG wire to NEMA Type 6-20R receptacles serving freezers, window air conditioners or other large appliances.

C. Where shown on the drawings, provide a separate neutral conductor for each single- phase branch circuit. The neutrals of these single-phase circuits shall not be shared, or daisy chained.

D. Receptacles installed in surface raceways being fed by multiple circuits, shall have adjacent receptacles from alternate circuits.

E. Provide ground fault circuit interrupter (GFCI) receptacles for new and existing 120-volt duplex receptacles located outdoors, in toilet rooms and within 6 feet of water sources including sinks, cup sinks, fume hood sinks, faucets, hose bibs and water coolers. Standard receptacles protected by an upstream GFCI receptacle or a GFCI circuit breaker are not acceptable.

F. Provide waterproof enclosures for receptacles located outdoors or when designated "waterproof" in special indoor applications. Enclosures shall remain watertight even while in use. Cantex, Carlon, Leviton or TayMac Corporation.

G. Provide a nametag on each cover plate of new and existing light switches and receptacles identifying the panel and circuit number feeding the device. Trace the existing circuits using an electronic circuit tracer if necessary. Nametags shall consist of black text permanently laminated to adhesive backed clear nylon or Mylar tape. Brother P-Touch. Embossed plastic tape labels are not acceptable.

H. Color code junction boxes and box covers of emergency circuits with red paint.

I. Mark junction box covers in indelible ink with the panel and breaker numbers of the circuits contained within.

3.2 FIELD QUALITY CONTROL

A. The contractor shall perform testing in accordance with Specification Section 260800 and shall submit a test report.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections, apply to this Section.

1.2 SCOPE

A. The work under this section includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting. Included are the following topics:

1.3 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.4 SUBMITTALS

A. Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.

B. For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:

C. Luminaire:

1. Manufacturer and catalog number
2. Type (identification) as indicated on the plans and schedule
3. Delivered lumens, Input watts, Efficacy,Color rendering index.

D. Driver:

1. Manufacturer and catalog number, Type (Non-Dimming, Step-dimming, Continuous dimming, etc.), Power Factor, Crest Factor, THD, etc.

1.5 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.6 DEFINITIONS

A. Driver: The power supply used to power LED luminaires, modules, or arrays.

B. L70, $L_{70,}$ or $L_{70\%}$: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

C. LED's: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.

D. LED luminaire failure: Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES

A. See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires, and meet the intent of the design.

B. Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

2.2 GENERAL USE LAMPS

A. Unless noted otherwise in the fixture schedule, all fixtures shall have a correlated color temperature of 4000 degrees K and a CRI of 85.

B. High intensity discharge (H.I.D.) lamps shall conform to their applicable ANSI codes.

C. General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED retrofit lamps or LED luminaires in lieu of incandescent or halogen luminaires.

1. LED retrofit lamps shall be:
   a. Rated for the voltage of the incandescent lamp/luminaire they are replacing.

b. Dimmable where required as indicated on the plans.
c. Rated for the luminaire in which they are being installed. Verify whether the luminaire is enclosed and whether the LED retrofit lamp is rated for enclosed luminaires and the temperatures that will be encountered.
d. LED lamps/luminaires shall provide delivered footcandles equal to or greater than the footcandles provided by an equivalent incandescent lamp/luminaire.
e. LED retrofit lamps shall have an average rated life of 25,000 hours, minimum.
f. Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.

D. All lamps shall be new.

2.3 LED LUMINAIRES

A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
1. Minimum Light Output.
2. Zonal Lumen Requirements.
3. Minimum Luminaire Efficacy.
4. Minimum CRI.
5. L70 Lumen Maintenance.
6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

B. Additional requirements:

1. Color Temperature of 4000K for interior luminaires unless otherwise listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
2. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
3. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
4. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
5. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
6. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
7. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
8. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
9. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
10. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
11. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
12. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
13. Luminaire shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
14. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
15. All luminaires shall be provided with knockouts for conduit connections.
16. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
17. Provide all of the following data on submittals:
    a. Delivered lumens
    b. Input watts
    c. Efficacy
    d. Color rendering index.

C. LED Luminaires used for Emergency Egress Lighting:
1. The failure of one LED shall not affect the operation of the remaining LEDs.

2.4 LED DRIVERS

A. General:
1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
3. Driver shall have a rated life of 50,000 hours, minimum.
4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
5. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
7. Driver shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
9. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
10. Provide all of the following data on submittals:
a. Input watts
b. Power Factor (pf)
c. Crest Factor (cf) at full input power
d. Total Harmonic Distortion (THD).

B. Dimming Drivers:
1. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM) operation.

2. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.

3. Continuous Dimming Drivers: LED luminaires shall dim to (10%, 1%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%) and going to 100% prior to returning to the pre- set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

2.5 EXIT SIGNS & EMERGENCY LIGHTING (WALL PACK)

A. Exit signs and egress lighting wall packs shall be of the LED type. Fluorescent, electro luminescent light panel or self-powered luminous signs shall not be used. Chloride, Dual-Lite, Emergi-Lite, Exide Light guard, Light alarms, Lithonia or Sure-Lites.
1. LED's shall be wired in parallel to prevent multi-lamp failure and shall be concealed within the sign by a clear panel and red optical diffuser. Power consumption shall not exceed 2 watts per face.
2. Exit signs shall have white die cast aluminum or polycarbonate housings with universal mounting brackets; brushed aluminum stencil faces with red letters and multi-directional knockout arrows.
3. Exit signs shall be provided with emergency battery packs and battery chargers when required. Batteries shall be maintenance free nickel cadmium and shall be mounted within the signs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with specified ceiling type(s) prior to ordering luminaires.
B. Install in accordance with manufacturer's instructions.
C. Refer to the suspension method (pendant or chain) in Luminaire Schedule and provide all required accessories as required for mounting.

D. Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy duty chain supports may be used where indicated on the luminaire schedule. Provide aircraft cable, pendants, or chain lengths required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires shall have an independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the luminaire wiring method to the chain.

E. Provide independent support for all luminaires over 50 lbs.

F. Locate ceiling luminaires as indicated on reflected ceiling plan.

G. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

H. The Contractor shall install luminaire supports as required. Luminaire installations with luminaires supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all luminaires adequately, providing extra steel work for the support of luminaires if required. Any components necessary for mounting luminaires shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

I. Support recessed fluorescent troffers independently of the ceiling grid system by using two, safety wires minimum on diagonally opposite corners of the fixtures. Support recessed downlights by using safety wires or by rigidly attaching the fixtures to the building structure or ceiling grid system. Removable T-bar clips shall not be used to attach fixtures to the ceiling grid system.

J. Install fixtures level, with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Lenses, reflectors and trims of fixtures shall be properly and uniformly aligned.

K. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.

L. Drops to recessed fixtures may be flexible metallic conduit, or manufactured wiring systems may be used where accessible. Fixtures shall be provided with sufficient length to permit removal and lowering of the fixtures 12” below the ceiling.

M. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.

N. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Burned out lamps shall be replaced.

O. Mount emergency lighting battery packs in accordance with the manufacturer’s instructions. Locate the remote test/monitor modules identically so that they are visible, and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

P. Mount sealed beam emergency lighting units where shown and aim their lamps to light the egress path as uniformly as possible.

Q. Misalignment and light leaks shall be corrected and rattles due to ventilation system vibration shall be eliminated.

R. Exposed Grid Ceilings: [Support surface mounted luminaires on grid ceiling directly from building structure] [Provide auxiliary members spanning ceiling Ts to support surface mounted luminaires] [Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips].

S. Install recessed luminaires to permit removal from below.

T. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

U. Install code required hardware to secure recessed grid-supported luminaires in place.

V. Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in exposed ceiling/structure locations where necessary to mount exit signs at the specified height.

W. Install accessories furnished with each luminaire.

X. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

Y. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

Z. Install specified lamps in each luminaire and exit sign.

AA. HID High-Bay or Low-Bay Luminaires: Use power hook hangers rated 500 pounds (225 kg) minimum and provide safety chain between ballast and structure. Also provide safety chain between reflector and ballast.

BB. Dimmed luminaire circuits shall have separate neutrals.

CC. Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don’t “glow” at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.

DD. All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the luminaire with special care so that they do not become dusty and are not soiled in the operation.

3.2 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.

C. Touch up luminaire finish at completion of work.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Interface with air handling accessories furnished and installed under Division 23.

B. Provide controls as indicated on the mechanical schedules and plans. Controls shall be compatible with the luminaires/ballasts/drivers being installed.

3.4 ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION

A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.

B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.

C. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use a cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).

D. Exposed 0-10V cables shall be installed in separate conduits from line-voltage conductors.

E. The 0-10V cables may be routed in free air where concealed above accessible ceilings. Cables routed in free air shall observe the following installation requirements:

F. The 0-10V cables may be tie-wrapped to the outside of the luminaire power raceway where allowed by NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance. Care should be taken in the use of cable ties to secure and anchor the cabling. Ties shall not be over tightened as to compress the cable jacket. No sharp burrs shall remain where excess length of the cable tie has been cut.

G. Cabling shall be neatly run at right angles and be kept clear of other trades work.

H. Cabling shall be secured within twelve (12) inches of direction change or termination.

I. Cabling shall be supported at a maximum of 5-foot intervals utilizing “J-Hook” or “Bridle Ring” supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend radius.

J. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.

K. All cables shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.

L. Cable manufacturer’s minimum bend radius shall be observed in all instances.

M. Use suitable cable fittings and connectors.

3.5 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.6 LUMINAIRE CONNECTIONS

A. METAL-CLAD (MC) CABLE

1. Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for the luminaire wiring where 0-10V dimming control wiring is required. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

B. Recessed, including Master-Satellite connections:
   1. Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
   2. Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.
   3. Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the ceiling grid wires.
   4. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap- in type with locknut, or snap-in connector type, including those used on the master-satellite units.

C. Chain or Cable Hung (unfinished spaces):
   1. Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
   2. Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
   3. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
   4. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap- in type with locknut, or snap-in connector type, including those used on the master-satellite units.
   5. Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV resistance.

D. Cable Hung (finished spaces):
   1. Use manufacturer's SO cord from luminaire to a J-box.
   2. SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
   3. SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
   4. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.

E. Surface Mounted (unfinished spaces):

   1. Provide direct conduit and box connection.

F. Surface Mounted (finished spaces):
   1. Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings. Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where the conduit is exposed.

END OF SECTION 265100

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All normal power devices to be white unless otherwise indicated.

2.2 TOGGLE SWITCHES

A. Toggle switches shall be rated 120/277 volts, 20-amperes, single-pole, double-pole, 3- way or 4-way as shown, specification grade, extra-heavy duty, back and side wired. Arrow Hart, Bryant, Hubbell, Leviton or Pass & Seymour.

2.3 DIMMER SWITCHES

A. Dimmer switches shall be rated 1000 watts minimum, specification grade, heavy duty, with radio noise filter and suitable for use in a single gang box. Leviton, Lithonia or Lutron.

2.4 OCCUPANCY SENSORS

A. Wall mounted occupancy sensors shall be rated 600 watts minimum, 180 degrees coverage, 300 sq. ft. minimum coverage, infrared type, heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, integral manual override switches, and suitable for mounting in single gang wall mounted boxes. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

B. Ceiling mounted occupancy sensors shall be rated 1000 watts minimum, 180 degrees coverage, 1000 sq. ft. minimum coverage, infrared type, heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, and suitable for mounting in ceiling mounted boxes. Sensors shall utilize low voltage control circuits and be interlocked with the switch circuit for local auto/off control. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

C. Dual technology occupancy sensors shall be rated 1000 watts minimum, 180 degrees coverage, 1000 sq. ft. minimum coverage, and combination ultrasonic/infrared type. The ultrasonic component shall be of a frequency compatible with hearing aids .The overall occupancy sensor shall be heavy duty, specification grade, with SCR power switching devices, adjustable range or sensitivity, adjustable time delay, and suitable for mounting in ceiling mounted boxes. Sensors shall utilize low voltage control circuits and be interlocked with the switch circuit for local auto/off control. Sensors with triac power switching devices are not acceptable. Heath, Leviton, Lutron, Pass & Seymour, Sensorswitch, Tork or Wattstopper.

2.5 DUPLEX RECEPTACLES

A. Duplex receptacles shall be rated 125 volts, 20 amps, 2-pole, 3-wire, NEMA Type 5- 20R, UL heavy duty, back and side wired, grounding type with nylon or Lexan bodies. Arrow-Hart, Bryant or Hubbell 5362, or Leviton or Pass & Seymour 5362A.

2.6 GFCI DUPLEX RECEPTACLES

A. GFCI duplex receptacles shall be rated 125 volts, 20 amps, 2 pole, 3 wire straight blade type with nylon or Lexan bodies. GFCI receptacles shall trip when ground currents exceed 5 ma, shall trip in 25 milliseconds maximum, and shall have an interrupting rating of 2000 amps. Receptacles shall lock out (off) when the protection system fails. Arrow Hart, Bryant, Hubbell or Leviton.

2.7 TVSS AND CHILD RESISTANT DUPLEX RECEPTACLES

A. TVSS and child resistant duplex receptacles shall be rated 125 volts, 20 amps, 2-pole, 3-wire straight blade type with nylon or Lexan bodies and ivory faces. TVSS receptacles shall clamp at 330 volts or less, and shall have visual indication of the failure of their protective circuitry. Child resistant receptacles shall require the simultaneous insertion of both line and neutral plug blades before power is applied to the receptacle contacts. Arrow Hart, Bryant, Hubbell or Leviton.

2.8 SPECIAL PLUGS AND RECEPTACLES

A. Special receptacles shall be of the voltage, amperage, number of poles, number of wires, configuration, and NEMA Type shown, and specification grade, with nylon or Lexan bodies ivory faces. Arrow-Hart, Bryant, Hubbell, Leviton or Pass & Semour. Provide the required quantity of mating plugs when shown on the drawings.

2.9 'RECEPTACLE STRIPS'

A. Surface mounted receptacle strips shall consist of surface wireways containing receptacles of the types shown. The receptacles shall be spaced and circuited as shown.

2.10 COVER PLATES

A. Except where unique cover plates are required (wall box dimmers, surface raceways, occupancy sensors, etc.), cover plates for switches and receptacles shall be of high-quality Type 302 stainless steel, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Except where necessary to match existing receptacles, install receptacles with their ground slots below, or to the left, of the line and neutral slots.

B. Provide No. 10 AWG wire to NEMA Type 6-20R receptacles serving freezers, window air conditioners or other large appliances.

C. Where shown on the drawings, provide a separate neutral conductor for each single- phase branch circuit. The neutrals of these single-phase circuits shall not be shared, or daisy chained.

D. Receptacles installed in surface raceways being fed by multiple circuits, shall have adjacent receptacles from alternate circuits.

E. Provide ground fault circuit interrupter (GFCI) receptacles for new and existing 120-volt duplex receptacles located outdoors, in toilet rooms and within 6 feet of water sources including sinks, cup sinks, fume hood sinks, faucets, hose bibs and water coolers. Standard receptacles protected by an upstream GFCI receptacle or a GFCI circuit breaker are not acceptable.

F. Provide waterproof enclosures for receptacles located outdoors or when designated "waterproof" in special indoor applications. Enclosures shall remain watertight even while in use. Cantex, Carlon, Leviton or TayMac Corporation.

G. Provide a nametag on each cover plate of new and existing light switches and receptacles identifying the panel and circuit number feeding the device. Trace the existing circuits using an electronic circuit tracer if necessary. Nametags shall consist of black text permanently laminated to adhesive backed clear nylon or Mylar tape. Brother P-Touch. Embossed plastic tape labels are not acceptable.

H. Color code junction boxes and box covers of emergency circuits with red paint.

I. Mark junction box covers in indelible ink with the panel and breaker numbers of the circuits contained within.

3.2 FIELD QUALITY CONTROL

A. The contractor shall perform testing in accordance with Specification Section 260800 and shall submit a test report.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections, apply to this Section.

1.2 SCOPE

A. The work under this section includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting. Included are the following topics:

1.3 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.4 SUBMITTALS

A. Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.

B. For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:

C. Luminaire:

1. Manufacturer and catalog number
2. Type (identification) as indicated on the plans and schedule
3. Delivered lumens, Input watts, Efficacy,Color rendering index.

D. Driver:

1. Manufacturer and catalog number, Type (Non-Dimming, Step-dimming, Continuous dimming, etc.), Power Factor, Crest Factor, THD, etc.

1.5 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.6 DEFINITIONS

A. Driver: The power supply used to power LED luminaires, modules, or arrays.

B. L70, $L_{70,}$ or $L_{70\%}$: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

C. LED's: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.

D. LED luminaire failure: Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES

A. See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires, and meet the intent of the design.

B. Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

2.2 GENERAL USE LAMPS

A. Unless noted otherwise in the fixture schedule, all fixtures shall have a correlated color temperature of 4000 degrees K and a CRI of 85.

B. High intensity discharge (H.I.D.) lamps shall conform to their applicable ANSI codes.

C. General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED retrofit lamps or LED luminaires in lieu of incandescent or halogen luminaires.

1. LED retrofit lamps shall be:

a. Rated for the voltage of the incandescent lamp/luminaire they are replacing.
b. Dimmable where required as indicated on the plans.
c. Rated for the luminaire in which they are being installed. Verify whether the luminaire is enclosed and whether the LED retrofit lamp is rated for enclosed luminaires and the temperatures that will be encountered.
d. LED lamps/luminaires shall provide delivered footcandles equal to or greater than the footcandles provided by an equivalent incandescent lamp/luminaire.
e. LED retrofit lamps shall have an average rated life of 25,000 hours, minimum.
f. Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.

D. All lamps shall be new.

2.3 LED LUMINAIRES

A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
1. Minimum Light Output.
2. Zonal Lumen Requirements.
3. Minimum Luminaire Efficacy.
4. Minimum CRI.
5. L70 Lumen Maintenance.
6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

B. Additional requirements:
1. Color Temperature of 4000K for interior luminaires unless otherwise listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
2. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
3. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
4. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
5. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
6. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
7. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
8. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
9. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
10. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
11. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
12. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
13. Luminaire shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
14. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
15. All luminaires shall be provided with knockouts for conduit connections.
16. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
17. Provide all of the following data on submittals:
a. Delivered lumens
b. Input watts
c. Efficacy

d. Color rendering index.

C. LED Luminaires used for Emergency Egress Lighting:
1. The failure of one LED shall not affect the operation of the remaining LEDs.

2.4 LED DRIVERS

A. General:
1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
3. Driver shall have a rated life of 50,000 hours, minimum.
4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
5. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
7. Driver shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
9. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
10. Provide all of the following data on submittals:
a. Input watts
b. Power Factor (pf)
c. Crest Factor (cf) at full input power
d. Total Harmonic Distortion (THD).

B. Dimming Drivers:
1. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM) operation.

2. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.

3. Continuous Dimming Drivers: LED luminaires shall dim to (10%, 1%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre- set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

2.5 EXIT SIGNS & EMERGENCY LIGHTING (WALL PACK)

A. Exit signs and egress lighting wall packs shall be of the LED type. Fluorescent, electro luminescent light panel or self-powered luminous signs shall not be used. Chloride, Dual-Lite, Emergi-Lite, Exide Lightguard, Lightalarms, Lithonia or Sure-Lites.
1. LED's shall be wired in parallel to prevent multi-lamp failure and shall be concealed within the sign by a clear panel and red optical diffuser. Power consumption shall not exceed 2 watts per face.
2. Exit signs shall have white die cast aluminum or polycarbonate housings with universal mounting brackets; brushed aluminum stencil faces with red letters and multi-directional knockout arrows.
3. Exit signs shall be provided with emergency battery packs and battery chargers when required. Batteries shall be maintenance free nickel cadmium and shall be mounted within the signs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with specified ceiling type(s) prior to ordering luminaires.
B. Install in accordance with manufacturer's instructions.
C. Refer to the suspension method (pendant or chain) in Luminaire Schedule and provide all required

accessories as required for mounting.

D. Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy duty chain supports may be used where indicated on the luminaire schedule. Provide aircraft cable, pendants, or chain lengths required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires shall have an independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the luminaire wiring method to the chain.

E. Provide independent support for all luminaires over 50 lbs.

F. Locate ceiling luminaires as indicated on reflected ceiling plan.

G. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

H. The Contractor shall install luminaire supports as required. Luminaire installations with luminaires supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all luminaires adequately, providing extra steel work for the support of luminaires if required. Any components necessary for mounting luminaires shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

I. Support recessed fluorescent troffers independently of the ceiling grid system by using two, safety wires minimum on diagonally opposite corners of the fixtures. Support recessed downlights by using safety wires or by rigidly attaching the fixtures to the building structure or ceiling grid system. Removable T-bar clips shall not be used to attach fixtures to the ceiling grid system.

J. Install fixtures level, with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Lenses, reflectors and trims of fixtures shall be properly and uniformly aligned.

K. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.

L. Drops to recessed fixtures may be flexible metallic conduit, or manufactured wiring systems may be used where accessible. Fixtures shall be provided with sufficient length to permit removal and lowering of the fixtures 12” below the ceiling.

M. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.

N. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Burned out lamps shall be replaced.

O. Mount emergency lighting battery packs in accordance with the manufacturer’s instructions. Locate the remote test/monitor modules identically so that they are visible, and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

P. Mount sealed beam emergency lighting units where shown and aim their lamps to light the egress path as uniformly as possible.

Q. Misalignment and light leaks shall be corrected and rattles due to ventilation system vibration shall be eliminated.

R. Exposed Grid Ceilings: [Support surface mounted luminaires on grid ceiling directly from building structure] [Provide auxiliary members spanning ceiling Ts to support surface mounted luminaires] [Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips].

S. Install recessed luminaires to permit removal from below.

T. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

U. Install code required hardware to secure recessed grid-supported luminaires in place.

V. Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in exposed ceiling/structure locations where necessary to mount exit signs at the specified height.

W. Install accessories furnished with each luminaire.

X. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

Y. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

Z. Install specified lamps in each luminaire and exit sign.

AA. HID High-Bay or Low-Bay Luminaires: Use power hook hangers rated 500 pounds (225 kg) minimum and provide safety chain between ballast and structure. Also provide safety chain between reflector and ballast.

BB. Dimmed luminaire circuits shall have separate neutrals.

CC. Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don’t “glow” at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.

DD. All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the luminaire with special care so that they do not become dusty and are not soiled in the operation.

3.2 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.

C. Touch up luminaire finish at completion of work.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Interface with air handling accessories furnished and installed under Division 23.

B. Provide controls as indicated on the mechanical schedules and plans. Controls shall be compatible with the luminaires/ballasts/drivers being installed.

3.4 ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION

A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.

B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.

C. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use a cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).

D. Exposed 0-10V cables shall be installed in separate conduits from line-voltage conductors.

E. The 0-10V cables may be routed in free air where concealed above accessible ceilings. Cables routed in free air shall observe the following installation requirements:

F. The 0-10V cables may be tie-wrapped to the outside of the luminaire power raceway where allowed by NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance. Care should be taken in the use of cable ties to secure and anchor the cabling. Ties shall not be over tightened as to compress the cable jacket. No sharp burrs shall remain where excess length of the cable tie has been cut.

G. Cabling shall be neatly run at right angles and be kept clear of other trades work.

H. Cabling shall be secured within twelve (12) inches of direction change or termination.

I. Cabling shall be supported at a maximum of 5-foot intervals utilizing “J-Hook” or “Bridle Ring” supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend radius.

J. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.

K. All cables shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.

L. Cable manufacturer’s minimum bend radius shall be observed in all instances.

M. Use suitable cable fittings and connectors.

3.5 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.6 LUMINAIRE CONNECTIONS

A. METAL-CLAD (MC) CABLE

1. Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for the luminaire wiring where 0-10V dimming control wiring is required. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

B. Recessed, including Master-Satellite connections:
   1. Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
   2. Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.
   3. Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the ceiling grid wires.
   4. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap- in type with locknut, or snap-in connector type, including those used on the master-satellite units.

C. Chain or Cable Hung (unfinished spaces):
   1. Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
   2. Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
   3. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
   4. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap- in type with locknut, or snap-in connector type, including those used on the master-satellite units.
   5. Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV resistance.

D. Cable Hung (finished spaces):
   1. Use manufacturer's SO cord from luminaire to a J-box.
   2. SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
   3. SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
   4. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.

E. Surface Mounted (unfinished spaces):

   1. Provide direct conduit and box connection.

F. Surface Mounted (finished spaces):
   1. Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings. Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where the conduit is exposed.

END OF SECTION 265100

SECTION 311000 - SITE CLEARING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Clearing and grubbing.
2. Removing above- and below-grade site improvements.
3. Disconnecting, capping or sealing site utilities.
4. Temporary erosion- and sedimentation-control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

2.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to best management practices.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent site drainage has been established.

C. Remove any erosion and sedimentation controls measures and restore areas disturbed during construction

2.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than seven days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

2.4 SITE IMPROVEMENTS

A. Remove existing improvements as indicated and necessary to facilitate new construction. See demolition plan and civil site plan for indications.

2.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

A. Preexcavation Conference: Conduct conference at location determined by architect.

1.4 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 6 inches (150 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: < 25
2. Plasticity Index: < 15

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 100 percent passing a 6-inch (152.4-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with at least 100 percent passing a 1-inch (25.4-mm) sieve and not more than 10 percent passing a No. 200 (0.075-mm) sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with 100 percent passing a 3-inch (76.2- mm) sieve and not more than 10 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

D. Prevent moisture from entering excavation. Dry soils to optimum before further operations.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches (300 mm) each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (100 mm) deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow- tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under building slabs, use material as identified in the geotechnical report.
2. Under footings and foundations, use material as identified in the geotechnical report.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 97 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.14 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs- on-grade as follows:

1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

3.18 GEOTECHNICAL REPORT

A. See civil site plan and geotechnical report for information on geotechnical boring locations and site soil conditions.

B. See geotechnical report and civil and structural drawings for required geotechnical work.

END OF SECTION 312000