SECTION 000101
PROJECT TITLE PAGE
PROJECT MANUAL

FOR

ARCHITECT'S PROJECT NUMBER: 2502.
SANTA FE COUNTY

645 OLD LAS VEGAS HIGHWAY
SANTA FE, NEW MEXICO87505

DATE: 08-15-2025

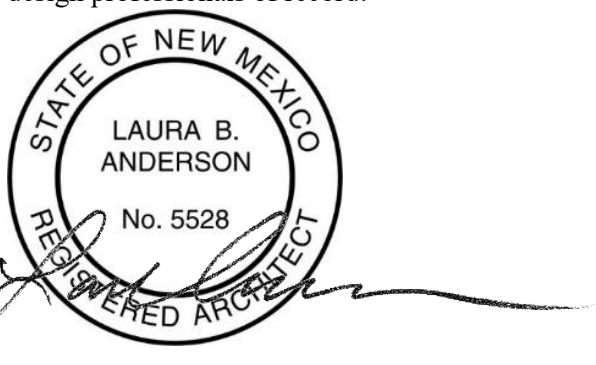
PREPARED BY:

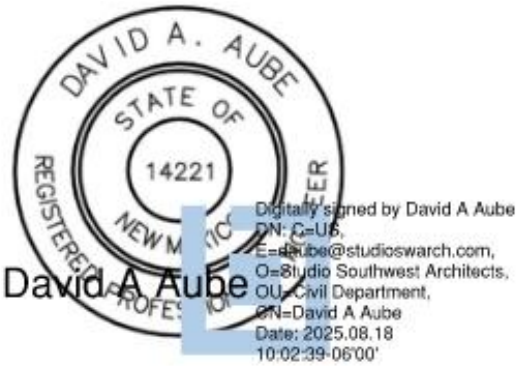
STUDIO SOUTHWEST ARCHITECTS

LAURA ANDERSON, AIA, NCARB, WELLAP, ICC
END OF SECTION

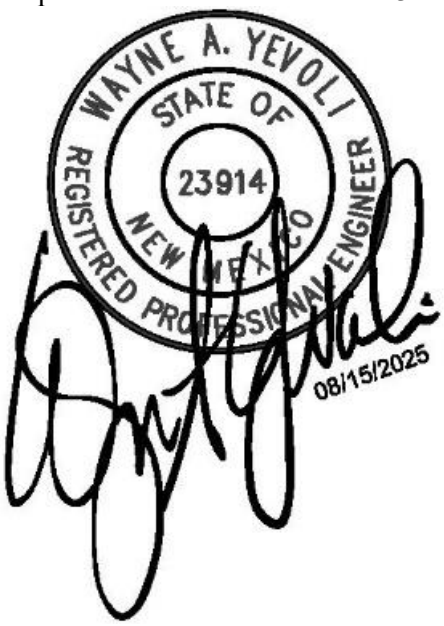
SECTION 000107
SEALS PAGE

1.01 DESIGN PROFESSIONALS OF RECORDS

A. Architect:
1. Laura B. Anderson, AIA, NCARB, WELL AP, ICC.
2. 5528.
3. Responsible for divisions 01-32 Sections except where indicated as prepared by other design professionals of record.
4. 

B. Civil Engineer:
1. David A. Aube, PE.
2. 14221
3. Responsible for CC-100 Civil General Notes.
4. 

C. Structural Engineer:
1. Daniel Mullens, PE.
2. 29362
3. Responsible for S-002 outline specifications.
4.

D. Plumbing and Mechanical Engineer:
1. Wayne A. Yevoli, PE, LEED AP.
2. 23914
3. Responsible for Division 22 and 23 Sections.
4. 

E. Electrical Engineer:
1. Felix A. Sauceda, PE.
2. 20576
3. Responsible for Division 26 Sections.

4.

END OF SECTION

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SECTION 003100
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Hondo Fire Station - Remodel.

B. Owner's Name: Santa Fe County.

C. Architect's Name: Laura Anderson, AIA, NCARB, WellAP, ICC.

D. The Project consists of the alteration of the existing fire station and addition of approximately 650 square feet..

1.02 CONTRACT DESCRIPTION

1.03 OWNER OCCUPANCY

A. Owner intends to occupy the Project upon Substantial Completion.

B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE AND PREMISES

A. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

1.05 WORK SEQUENCE

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

1.02 SCHEDULE OF VALUES

A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

B. Forms filled out by hand will not be accepted.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Execute certification by signature of authorized officer.

E. Submit one electronic and three hard-copies of each Application for Payment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012100
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowances.

B. Contingency allowance.

C. Inspecting and testing allowances.

D. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

A. Section 012000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CASH ALLOWANCES

1.04 CONTINGENCY ALLOWANCE

1.05 INSPECTING AND TESTING ALLOWANCES

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

B. Procedures for pricing Alternates.

C. Documentation of changes to Contract Price and Contract Time.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.

D. Limit each request to a single proposed substitution item.

3.02 RESOLUTION

3.03 ACCEPTANCE

END OF SECTION

SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

A. SUMMARY
1. The Work of this Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
   a. General coordination procedures.
   b. Coordination drawings.
   c. RFIs.
   d. Digital project management procedures.
   e. Web-based Project management software package.
   f. Project meetings.
2. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
3. Related Requirements:
   a. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
   b. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   c. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

B. DEFINITIONS
1. BIM: Building Information Modeling.
2. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

C. INFORMATIONAL SUBMITTALS
1. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   a. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
   b. Number and title of related Specification Section(s) covered by subcontract.
   c. Drawing number and detail references, as appropriate, covered by subcontract.
2. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

a. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

D. GENERAL COORDINATION PROCEDURES

1. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
   a. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
   b. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   c. Make adequate provisions to accommodate items scheduled for later installation.
2. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   a. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
3. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   a. Preparation of Contractor's construction schedule.
   b. Preparation of the schedule of values.
   c. Installation and removal of temporary facilities and controls.
   d. Delivery and processing of submittals.
   e. Progress meetings.
   f. Preinstallation conferences.
   g. Project closeout activities.
   h. Startup and adjustment of systems.

E. COORDINATION DRAWINGS

1. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
   a. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
      1) Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
      2) Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      3) Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

4) Show location and size of access doors required for access to concealed dampers, valves, and other controls.
5) Indicate required installation sequences.
6) Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Coordination Drawing Organization: Organize coordination drawings as follows:
   a. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
   b. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
   c. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
   d. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   e. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   f. Mechanical and Plumbing Work: Show the following:
      1) Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
      2) Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
      3) Fire-rated enclosures around ductwork.
   g. Electrical Work: Show the following:
      1) Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
      2) Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
      3) Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
      4) Location of pull boxes and junction boxes, dimensioned from column center lines.
   h. Fire-Protection System: Show the following:
      1) Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

i. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

j. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

3. Coordination Drawing Process: Prepare coordination drawings in the following manner:
   a. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
   b. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
   c. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
   d. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
   e. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
   f. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
   g. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
4. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   a. File Preparation Format:
      1) Same digital data software program, version, and operating system as original Drawings.
   b. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
   c. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
      1) Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
   d. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
      1) Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
      2) Digital Data Software Program: Drawings are available in ???Insert name and version of digital data software program and operating system???.

3) Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

F. REQUEST FOR INFORMATION (RFI)

1. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   a. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
   b. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
2. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   a. Project name.
   b. Owner name.
   c. Owner's Project number.
   d. Name of Architect.
   e. Architect's Project number.
   f. Date.
   g. Name of Contractor.
   h. RFI number, numbered sequentially.
   i. RFI subject.
   j. Specification Section number and title and related paragraphs, as appropriate.
   k. Drawing number and detail references, as appropriate.
   l. Field dimensions and conditions, as appropriate.
   m. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   n. Contractor's signature.
   o. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
      1) Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
3. RFI Forms: AIA Document G716.
   a. Attachments shall be electronic files in PDF format.
4. Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   a. The following Contractor-generated RFIs will be returned without action:
      1) Requests for approval of submittals.
      2) Requests for approval of substitutions.
      3) Requests for approval of Contractor's means and methods.
      4) Requests for coordination information already indicated in the Contract Documents.
      5) Requests for adjustments in the Contract Time or the Contract Sum.
      6) Requests for interpretation of Architect's actions on submittals.
      7) Incomplete RFIs or inaccurately prepared RFIs.

b. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
c. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
1) If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

5. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly . Software log with not less than the following:
a. Project name.
b. Name and address of Contractor.
c. Name and address of Architect.
d. RFI number, including RFIs that were returned without action or withdrawn.
e. RFI description.
f. Date the RFI was submitted.
g. Date Architect's response was received.
h. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
i. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

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

G. DIGITAL PROJECT MANAGEMENT PROCEDURES

1. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
a. Web-based Project management software includes, at a minimum, the following features:
1) Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
2) Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
3) Document workflow planning, allowing customization of workflow between project entities.
4) Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
5) Track status of each Project communication in real time, and log time and date when responses are provided.
6) Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
7) Processing and tracking of payment applications.
8) Processing and tracking of contract modifications.

9) Creating and distributing meeting minutes.
10) Document management for Drawings, Specifications, and coordination drawings, including revision control.
11) Management of construction progress photographs.
12) Mobile device compatibility, including smartphones and tablets.

b. Provide up to seven Project management software user licenses for use of Owner, Owner's Commissioning Authority, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.

c. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

2. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

a. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

b. Name file with submittal number or other unique identifier, including revision identifier.

c. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

H. PROJECT MEETINGS

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

a. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.

b. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

c. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

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

a. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

b. Agenda: Discuss items of significance that could affect progress, including the following:

1) Responsibilities and personnel assignments.
2) Tentative construction schedule.
3) Phasing.
4) Critical work sequencing and long lead items.
5) Designation of key personnel and their duties.
6) Lines of communications.
7) Use of web-based Project software.
8) Procedures for processing field decisions and Change Orders.

9) Procedures for RFIs.
10) Procedures for testing and inspecting.
11) Procedures for processing Applications for Payment.
12) Distribution of the Contract Documents.
13) Submittal procedures.
14) Sustainable design requirements.
15) Preparation of Record Documents.
16) Use of the premises.
17) Work restrictions.
18) Working hours.
19) Owner's occupancy requirements.
20) Responsibility for temporary facilities and controls.
21) Procedures for moisture and mold control.
22) Procedures for disruptions and shutdowns.
23) Construction waste management and recycling.
24) Parking availability.
25) Office, work, and storage areas.
26) Equipment deliveries and priorities.
27) First aid.
28) Security.
29) Progress cleaning.

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

3. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

a. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.

b. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

1) Contract Documents.
2) Options.
3) Related RFIs.
4) Related Change Orders.
5) Purchases.
6) Deliveries.
7) Submittals.
8) Sustainable design requirements.
9) Review of mockups.
10) Possible conflicts.
11) Compatibility requirements.
12) Time schedules.
13) Weather limitations.
14) Manufacturer's written instructions.
15) Warranty requirements.

16) Compatibility of materials.
17) Acceptability of substrates.
18) Temporary facilities and controls.
19) Space and access limitations.
20) Regulations of authorities having jurisdiction.
21) Testing and inspecting requirements.
22) Installation procedures.
23) Coordination with other work.
24) Required performance results.
25) Protection of adjacent work.
26) Protection of construction and personnel.

c. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

d. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

e. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

4. Progress Meetings: Conduct progress meetings at regular intervals.

a. Coordinate dates of meetings with preparation of payment requests.

b. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

c. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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

a) Review schedule for next period.

2) Review present and future needs of each entity present, including the following:

a) Interface requirements.
b) Sequence of operations.
c) Resolution of BIM component conflicts.
d) Status of submittals.
e) Status of sustainable design documentation.
f) Deliveries.
g) Off-site fabrication.
h) Access.
i) Site use.
j) Temporary facilities and controls.

k) Progress cleaning.
l) Quality and work standards.
m) Status of correction of deficient items.
n) Field observations.
o) Status of RFIs.
p) Status of Proposal Requests.
q) Pending changes.
r) Status of Change Orders.
s) Pending claims and disputes.
t) Documentation of information for payment requests.

d. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
   1) Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

5. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
   a. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
   b. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      1) Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      2) Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
      3) Review present and future needs of each contractor present, including the following:
         a) Interface requirements.
         b) Sequence of operations.
         c) Resolution of BIM component conflicts.
         d) Status of submittals.
         e) Deliveries.
         f) Off-site fabrication.
         g) Access.
         h) Site use.

i) Temporary facilities and controls.
j) Work hours.
k) Hazards and risks.
l) Progress cleaning.
m) Quality and work standards.
n) Status of RFIs.
o) Proposal Requests.
p) Change Orders.
q) Pending changes.

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

6. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 ???Insert number??? days prior to the scheduled date of Substantial Completion.
   a. Conduct the conference to review requirements and responsibilities related to Project closeout.
   b. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   c. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
      1) Preparation of Record Documents.
      2) Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
      3) Procedures for completing and archiving web-based Project software site data files.
      4) Submittal of written warranties.
      5) Requirements for completing sustainable design documentation.
      6) Requirements for preparing operations and maintenance data.
      7) Requirements for delivery of material samples, attic stock, and spare parts.
      8) Requirements for demonstration and training.
      9) Preparation of Contractor's punch list.
      10) Procedures for processing Applications for Payment at Substantial Completion and for final payment.
      11) Submittal procedures.
      12) Coordination of separate contracts.
      13) Owner's partial occupancy requirements.
      14) Installation of Owner's furniture, fixtures, and equipment.
      15) Responsibility for removing temporary facilities and controls.
   d. Minutes: Entity conducting meeting will record and distribute meeting minutes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Control of installation.

C. Defect Assessment.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 014010 – STRUCTURAL TESTING AND INSPECTIONS

PART 3 - EXECUTION

3.1 Jobsite Testing and Inspection Requirements - General

A. General:

1. Scope of Work
   a. The owner will engage a qualified inspection and testing agency(s) to perform special inspections and testing for all structural members and assemblies as noted herein.
   b. Special inspections are in addition to inspections by the authority having jurisdiction required by IBC 2021 section 110.
   c. Refer to architectural/mechanical/electrical/civil specifications and drawings for additional special inspection and testing that may be required.
2. Special inspections and testing are applicable to all revisions and/or future work added by amendments to the construction documents.
3. Definitions
   a. Special inspector: the agency engaged by the owner and approved by the authority having jurisdiction to act as the designated representative to perform inspections.
   b. Special inspection: inspection performed by the special inspector according to IBC 2021 section 1704 to ensure compliance with approved construction documents and referenced standards.
   c. (P) Periodic inspection: the part-time or intermittent observation by the special inspector of work being performed. Special inspector shall be present in the area where the work is being performed. Observation of all work (100% visual) shall be made at the completion of the work.
   d. (C) Continuous inspection: the full-time observation by the special inspector of work being performed. Special inspector shall be present in the area where the work is being performed. Observation of all work (100% visual) shall be made at the completion of the work.
   e. (100%): 100% observation / testing prior to concealment of indicated element.
   f. Testing and Inspection Type 1: Material Verification and Workman Certifications.
   g. Testing and Inspection Type 2: Site Inspection for Layout and Quantities.
   h. Testing and Inspection Type 3: Site Inspection for Procedures and Workmanship.
   i. Testing and Inspection Type 4: Site Testing for Material Properties and Workmanship.
   j. Testing and Inspection Type 5: Fabrication Facility Inspection and Testing for Workmanship.
4. Deficiencies in Work
   a. Correct deficiencies in work that tests and inspections indicate do not comply with the contract documents and referenced standards.
   b. All cost of additional testing and/or inspections for corrective work shall be borne by the contractor.

B. Shop Fabrications:

1. General
   a. Perform inspections and testing for all shop fabricated structural members and assemblies as noted herein. Special inspector shall perform special inspections and testing unless the fabricator is registered and approved by the authority having jurisdiction to perform such work without special inspection or fabrication has a current ICC-ES evaluation report.
   b. Special inspector shall verify the fabricator maintains and follows detailed shop fabrication and quality control procedures, unless fabricator is registered and approved.
   c. At the completion of fabrication, the approved fabricator shall submit a certificate of compliance to the authority having jurisdiction according to IBC 2021 section 1704.2.5.1
   d. Approved fabricators may perform testing noted herein except that nondestructive testing (NDT) shall only be performed by personnel with qualifications that meet or exceed the criteria of AWS D1.1 subclause 6.14.6 and American Society for Nondestructive Testing (ASNT) SNT-TC-1A or ASNT CP-189.
2. Shop Fabrications Included
   a. Shop fabricated structural steel
   b. Shop fabricated cold formed steel elements

3.2 Jobsite Testing and Inspection Requirements for Soils and Foundations

A. Soils Inspection and Testing

1. Excavation Extents and Depths
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify excavations are extended to the proper depth and have reached the proper material.
   c. Frequency: (P) Periodic inspection.
2. Subgrade Material Verification
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.
   c. Frequency: (P) Periodic inspection.
3. Fill materials
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Perform classification and testing of compacted fill materials.
   c. Frequency: (P) Periodic inspection.
4. Controlled Fill Placement
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify use of proper materials, densities, compaction, and lift thicknesses during placement and compaction of compacted fill.
   c. Frequency: (C) Continuous inspection.
5. Bearing Material Verification
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Verify bearing material is adequate to achieve the design bearing capacity.
   c. Frequency: (P) Periodic inspection.

d. Standard: Geotechnical Investigation Report.

6. See civil drawings and/or specifications for additional earthwork and utility inspection requirements.
7. See civil drawings and/or specifications for classification and testing requirements for compacted fill and/or controlled low-strength material.
   a. Frequency: (C) Continuous inspection.

3.3 Jobsite Testing and Inspection Requirements for Concrete

A. Cast-in-Place and Concrete Inspection and Testing – Before Concrete Placement

1. Formwork Dimensional Layout.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Prior to placement of concrete inspect formwork of first pour of each type (grade beam, column, structural slab, slab-on-deck, etc.).
   c. Frequency: (P) Periodic inspection.
   d. Standard: ACI 301-16 2.2-2.3
2. Reinforcing Steel Placement.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify grade, finish, size, bar quantity, location, spacing, cover, hook lengths, splice lengths, splice locations, bend diameters, coating, surface conditions, and supports.
   c. Frequency: 100% observation / testing.
   d. Standard: ACI 301-16 3.2-3.3.
3. Bolts and Embedments Placement.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify type, finish, diameter, length, quantity, embedment length, spacing and edge distances, use of placing template where specified.
   c. Frequency: 100% observation / testing.
4. Bolts and Embedments Welding.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspect per the jobsite testing and inspection requirements for steel.
   c. Frequency: See jobsite testing and inspection requirements for steel.
5. Reinforcement Welding.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify ASTM A706 reinforcing steel. Inspect all welds.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AWS D1.4.
6. Reinforcement Field Bending.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspect reinforcement field bending.
   c. Frequency: (P) Periodic inspection.
   d. Standard: ACI 301-16 3.3.2.8.
7. Mechanical Connectors.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspect mechanical connectors.
   c. Frequency: (P) Periodic inspection.
   d. Standard: ICC-ES Report.

8. Epoxy Reinforcing.
    a. Type 1: Material Verification and Workman Certifications.
    b. Criteria: Inspect epoxy or galvanized reinforcing.
    c. Frequency: 100% observation / testing.
    d. Standard: ACI 301-16 3.2.1.2.

B. Cast-in-Place and Concrete Inspection and Testing – During Concrete Placement.

1. Verify Design Mix.
    a. Type 1: Material Verification and Workman Certifications.
    b. Criteria: Verify use of approved design mixture for each truck load.
    c. Frequency: 100% observation/testing.
    d. Standard: ACI 318 Ch. 19, 26.4.3, 26.4.4.
2. Concrete Placement Inspection.
    a. Type 3: Site Inspection for Procedures and Workmanship.
    b. Criteria: Inspect placement of concrete per standard (see below).
    c. Frequency: (C) Continuous inspection.
    d. Standard: ACI 301-16 5.3.2.
3. Concrete Curing Inspection.
    a. Type 3: Site Inspection for Procedures and Workmanship.
    b. Criteria: Inspect curing of concrete per standard (see below).
    c. Frequency: (P) Periodic inspection.
    d. Standard: ACI 301-16 5.3.6.

C. Structural Concrete Testing.

1. Note: Nondestructive testing may be permitted by the architect but will not be used as sole basis for approval or rejection of deficient concrete.
2. Welding.
    a. Type 4: Site Testing for Material Properties and Workmanship.
    b. Criteria: Welding testing and inspection per the jobsite testing and inspection requirements for steel.
    c. Frequency: See jobsite testing and inspection requirements for steel.
3. Composite Concrete Sample – f'c < 5000 PSI.
    a. Type 4: Site Testing for Material Properties and Workmanship.
    b. Criteria: Obtain sample at point of placement. For drilled piers obtain near beginning of load prior to placement in shaft.
    c. Frequency: At least once a day or at least once for each 100 cubic yards of concrete or at least once for each 5,000 square feet of surface area for slabs and walls. Adjust frequency as required to provide minimum 5 total tests per mix but not more than one sample per truck load.
    d. Standard: ASTM C172.
    e. Frequency: At least once a day or at least once for each 50 cubic yards of concrete or at least once for each 5,000 square feet of surface area for slabs and walls. Adjust frequency as required to provide minimum 5 total tests per mix but not more than one sample per truck load.
    f. Standard: ASTM C172.
4. Slump/Slump Flow.
    a. Type 4: Site Testing for Material Properties and Workmanship.

b. Criteria: Specified slump shall be as submitted in the mix design ± 1 1/2". perform additional tests when concrete consistency appears to change.
c. Frequency: Each composite sample (see above).
d. Standard: ASTM C143 (slump) or ASTM C1611 (slump flow).

5. Air content when air entrainment is specified and lightweight concrete
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Test per standard (see below).
   c. Frequency: Each composite sample (see above).
   d. Standard: ASTM C231 pressure method for normal weight concrete or ASTM C173 volumetric method for light weight concrete.
6. Temperature.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Test per standard (see below). Required when air temperature is 40 °F and below or 80°F and above.
   c. Frequency: Each composite sample (see above) and at 60 minute intervals.
   d. Standard: ASTM C1064.
7. Cold Weather Curing.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Record maximum and minimum concrete temperature during curing period when daily average air temperature of 40 °F or below is expected for 3 successive days during curing period.
   c. Frequency: N/A
   d. Standard: ASTM C1074.
8. Compressive Strength.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Reports of compressive strength tests shall contain the following information: date of concrete placement, location of concrete batch in work, design 28-day compressive strength, concrete supplier and mixture ID number, time of batch and placement, ambient air temperature, site added water and admixtures, unit weight, and as required by ASTM C39. Acceptance criteria per ACI 318.
   c. Frequency: Test per schedule below:
      1) 7 days: 6x12 or 4x8
      2) 28 days: 6x12 or 4x8
      3) 56 days: 6x12 or 4x8 (if 28 day tests do not achieve specified 28 day strength).
   d. Standard: ASTM C31, ASTM C39. Either 6x12 or (6) 4x8 cylinders.

D. Cast-in-Place and Concrete Inspection and Testing - After Concrete Placement

1. Cold Weather Curing.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspect curing of concrete per standard (see below).
   c. Frequency: (P) Periodic inspection.
   d. Standard: ACI 301-16 5.3.6.
2. Form Removal.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspect removal of shoring/forms for beams and structural slabs per standard (see below).
   c. Frequency: (P) Periodic inspection.
   d. Standard: ACI 301-16: 2.3.2.

E. Expansion, Sleeve and Screw Anchor Inspection and Testing – Before Anchor Installations

1. Verify Installation Procedure.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Review contractor's installation procedure.
   c. Frequency: 100% observation / testing.
   d. Standard: ICC-ES Report.
2. Verify Anchor Type, Diameter, and Materials.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify anchor products to be used for compliance of anchor type, diameter, materials and product
   c. Frequency: 100% observation / testing.
   d. Standard: ICC-ES Report.
3. Verify Max Allowed Impact Wrench Torque.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: For screw anchors, confirm the maximum allowed impact wrench torqued as defined by the manufacturer.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.

F. Expansion, Sleeve and Screw Anchor Inspection and Testing – During Anchor Installations

1. Continuous inspection required regardless if periodic inspection is permitted by ICC-ES report.
2. Verify Hole Layout.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify the hole layout matches the contract documents. Review of layout should include number of anchors, spacing, edge distances, and quantity.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.
3. Grout Extents Around Masonry Anchors.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: At masonry anchors, confirm the grout extents surrounding the anchor have been satisfied.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.
4. Verify Hole Diameter, Depth, Cleaning
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify the hole diameter and depth meet the manufacturer requirements and the requirements shown on the contract documents. Observe the hole cleaning procedure is in accordance with the anchor manufacturers recommendations.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.
5. Verify Anchor Installation.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify the anchor installation of the anchor is in accordance with the anchor manufacturer recommendations.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.

G. Expansion, Sleeve and Screw Anchor Inspection and Testing – After Anchor Installations

1. Verify Installation of Attached Assembly.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify number, edge distances, and anchor flush with and perpendicular to the receiving surface.
   c. Frequency: (C) Continuous inspection.
2. Torque Test Anchors.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Test anchor with calibrated torque wrench to 100% of the installation torque noted in ICC-ES report. Attain specified torque within 1/2 turn of the nut.
   c. Frequency: 100% observation / testing.
   d. Standard: ICC-ES Report.

H. Adhesive Anchors and Reinforcing Inspection and Testing - Before Anchor / Reinforcing Installation

1. Verify Installation Procedure.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Review contractor's installation procedure. Verify adhesive to be used for product type, manufacturer recommendations, expiration dates, pot life, working temperature ranges for adhesives, substrates and anchors.
   c. Frequency: 100% observation / testing.
   d. Standard: ICC-ES Report.
2. Verify Anchor Type, Diameter and Materials.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify anchor to be used for compliance of anchor type, diameter, length, finish, and base material. Verify solid grouted area around anchors in grouted masonry
   c. Frequency: 100% observation / testing.
   d. Standard: ICC-ES Report.

I. Adhesive Anchors and Reinforcing Inspection and Testing - During Anchor/Reinforcing Installation

1. Continuous inspection required regardless if periodic inspection is permitted by ICC-ES report.
2. Verify Hole Layout.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: Verify the hole layout matches the contract documents. Review of layout should include number of anchors, spacing, edge distances, and quantity.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.
3. Grout Extents Around Masonry Anchors.
   a. Type 2: Site inspection for Layout and Quantities.
   b. Criteria: At masonry anchors, confirm the grout extents surrounding the anchor have been satisfied.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.
4. Verify Hole Diameter, Depth and Cleaning.

a. Type 2: Site inspection for Layout and Quantities.
b. Criteria: Verify the hole diameter and depth meet the manufacturer requirements and the requirements shown on the contract documents. Observe the hole cleaning procedure is in accordance with the adhesive manufacturer's recommendations.
c. Frequency: (C) Continuous inspection.
d. Standard: ICC-ES Report.

5. Verify Anchor Installation.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify the anchor installation of the anchor is in accordance with the adhesive manufacturer's recommendations. Verify the temperatures of the adhesive, substrate and anchors are within the manufacturer recommended ranges.
   c. Frequency: (C) Continuous inspection.
   d. Standard: ICC-ES Report.

J. Adhesive Anchors and Reinforcing Inspection and Testing - After Anchor / Reinforcing Installation

1. Verify Installation of Attached Assembly.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify number, edge distances, and anchor flush with and perpendicular to the receiving surface. Verify full cure time has elapsed prior to application of torque or load to anchor.
   c. Frequency: (C) Continuous inspection.
2. Tension Test Anchors / Reinforcing
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Test the installation of the first 3 of each type, base material, and position (down, horizontal, overhead). Observe ASTM E488 minimum edge distances for determining test locations. Submit Proposed test locations and requests for required tension test load values to engineer.
   c. Frequency: First 3 and 1% of remaining.
   d. Standard: ASTM E488 Static Tension.

3.4 Jobsite Testing and Inspection Requirements for Masonry – Level 2 (Risk Category I, II, or III)

A. General

1. Compliance with Approved Submittals.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify Compliance with Approved Submittals.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art 1.5.
2. Observe Preparation of Grout Specimens, Mortar Specimens, and/or Prisms.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Compliance with the Standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art 1.4.B.2, 1.4.B.3, 1.4.B.4.

B. As Masonry Construction Begins

1. Verify f'm.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify Specified Compressive Strength of Masonry, f'm conforms to structural drawings and specifications.
   c. Frequency: 100% observation / testing.
2. Proportions of Site-prepared Mortar.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify Proportions of Site-prepared Mortar conform to standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art 2.1 and 2.6A.
3. Construction of Mortar Joints.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Construction of Mortar Joints conforms to standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.3B.
4. Reinforcement, anchorages, connectors, embeds.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Grade, type, and size of reinforcement, connectors, anchor bolts, and prestressing tendons and anchorages.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS602, Art 3.4.

C. During Construction

1. Placement of Masonry Units and Mortar Joint Construction.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify placement of masonry units and mortar joint construction is in compliance with the standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.3B.
2. Size and Location of Elements.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify Size and Location of Structural Elements conforms to drawings and specifications.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.3F.
3. Type, size and location reinforcement and embeds.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other constructions.
   c. Frequency: (P) Periodic inspection.
4. Welding of Reinforcement.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspection and testing of welding of reinforcement per Steel table and specifications.
   c. Frequency: (C) Continuous inspection.
   d. Standard: Per Steel table and specifications.
5. Cold (<40F) and Hot (>90F) Weather.
   a. Type 3: Site Inspection for Procedures and Workmanship.

b. Criteria: Verify Preparation, construction, and protection of masonry during hot and cold weather conform to standard.
c. Frequency: (P) Periodic inspection.
d. Standard: TMS 602, Art. 1.8C and 1.8D.

D. Prior to Grouting

1. Grout space.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify grout space is free of mortar droppings and debris, and cleanouts provided as required.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.2D and 3.2F.
2. Reinforcement, Anchorages, Connectors, Embeds.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify type, size, quantity, location, spacing, cover, splice length, splice location, surface condition, support, and securing. See structural concrete table and specifications for field bending, coated reinforcement, and mechanical connectors.
   c. Frequency: (P) Periodic inspection, 100% observation/testing.
   d. Standard: TMS602, Art. 2.4 and 3.4, Structural concrete table and specifications.
3. Proportions of Site Mixed Grout.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify Proportions of Site Mixed Grout conform to ASTM C476.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 2.6B, ASTM C476.
4. Mix Design for Off-Site Prepared Grout.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify Mix Design for Off-Site Prepared Grout conforms to standard.
   c. Frequency: 100% observation / testing.
   d. Standard: TMS 602, Art. 2.6B, ASTM C476.
5. Construction of Mortar Joints.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Construction of Mortar Joints conforms to standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.3B.

3.5 Jobsite Testing and Inspection Requirements for Masonry – Level 3 (Risk Category IV)

A. General

1. Compliance with Approved Submittals.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify Compliance with Approved Submittals.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art 1.5.

B. As Masonry Construction Begins and Every 5,000 SF or Each Type Construction

1. Cold (<40F) and Hot (>90F) Weather.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Preparation, construction, and protection of masonry during hot and cold weather conform to standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 1.8C and 1.8D.
2. Observe preparation of grout, mortar and prisms specimens.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Observe preparation of grout, mortar and prisms specimens.
   c. Frequency: (C) Continuous inspection.
   d. Standard: TMS602, Art. 1.4B, ASTM C1019, ASTM C1314.
3. Prism Compressive Strength.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Test one set of grouted and one set of ungrouted prisms at 28 days. Set shall consist on 3 prisms for each type of construction.
   c. Frequency: Every 5,000 square feet or fraction thereof for each type of construction.
   d. Standard: ASTM C1314.
4. Size and Location of Elements.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify Size and Location of Structural Elements conforms to drawings and specifications.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.3F.
5. Proportions of Site Mixed Mortar.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify Proportions of Site Mixed Mortar.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 2.1.
6. Placement of Units and Joint Construction.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Placement of Masonry Units and Mortar Joint Construction.
   c. Frequency: (P) Periodic inspection.
   d. Standard: TMS 602, Art. 3.3B
7. Reinforcement, Anchorages, Connectors, Embeds.
   a. Type 1: Material Verification and Workman Certifications
   b. Type 2: Site Inspection for Layout and Quantities.
   c. Criteria: Verify type, size, quantity, location, spacing, cover, splice length, splice location, surface condition, support, and securing. See structural concrete table and specifications for field bending, coated reinforcement, and mechanical connectors.
   d. Frequency: Type 1 (P) Periodic inspection, Type 2 (C) Continuous inspection
   e. Standard: TMS602, Art. 2.4 and 3.4, Structural concrete table and specifications.
8. Welding of Reinforcement.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Inspection and testing of welding of reinforcement per Steel table and specifications.
   c. Frequency: (C) Continuous inspection.
   d. Standard: Per Steel table and specifications.

9. Grout space.
    a. Type 3: Site Inspection for Procedures and Workmanship.
    b. Criteria: Verify grout space is free of mortar droppings and debris, and cleanouts provided as required.
    c. Frequency: (C) Continuous inspection.
    d. Standard: TMS 602, Art. 3.2D and 3.2F.
10. Proportions of Site Mixed Grout.
    a. Type 1: Material Verification and Workman Certifications.
    b. Criteria: Verify Proportions of Site Mixed Grout conform to ASTM C476.
    c. Frequency: (P) Periodic inspection.
    d. Standard: TMS 602, Art. 2.6B, ASTM C476.
11. Mix Design for Off-Site Prepared Grout.
    a. Type 1: Material Verification and Workman Certifications.
    b. Criteria: Verify Mix Design for Off-Site Prepared Grout conforms to standard.
    c. Frequency: 100% observation / testing.
    d. Standard: TMS 602, Art. 2.6B, ASTM C476.
12. Flow of Self-Consolidating Grout.
    a. Type 4: Site Testing for Material Properties and Workmanship.
    b. Criteria: Verify slump flow and visual stability index.
    c. Frequency: 100% observation / testing.
    d. Standard: ASTM C1611.
13. Placement of Grout for prestress.
    a. Type 3: Site Inspection for Procedures and Workmanship.
    b. Criteria: Verify placement of grout and prestressing grout for bonded tendons is in compliance with standard.
    c. Frequency: (C) Continuous inspection.

3.6 Jobsite Testing and Inspection Requirements for Steel – AISC 341 Seismic Systems

A. Steel Testing and Inspection Definitions.

1. UT – Ultrasonic Testing.
2. MT – Magnetic Particle Testing.
3. PT – Penetration Testing.
4. SFRS – Seismic Force Resisting System.
5. TTT – Tension Through Thickness.

B. Prior to Construction at AISC 341 Seismic Systems.

1. Understand seismic force resisting elements and joints.
    a. Type 2: Site Inspection for Layout and Quantities.
    b. Criteria: Understand seismic force resisting elements and joints.
    c. Frequency: (C) Continuous inspection.
2. Verify reduced beam sections contour, finish and dimensional tolerance.
    a. Type 3: Site Inspection for Procedures and Workmanship.
    b. Criteria: Verify reduced beam sections contour, finish and dimensional tolerance per AISC 358, Section 5.7.
    c. Frequency: 100% observation / testing.
    d. Standard: AISC 341, Chapter J, AISC 358, Section 5.7.

3. MT or PT for thermally cut beam copes and access holes where material ≥1 1/2".
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: MT or PT for thermally cut beam copes and access holes where material ≥1 1/2"
   c. Frequency: 100% observation / testing.
   d. Standard: AISC 341, Chapter J.

C. After Construction at AISC 341 Seismic Systems.

1. Verify protected zones are intact and have not been compromised.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: No holes and unapproved attachments, inspect following completion of work of other trades.
   c. Frequency: 100% observation / testing.
   d. Standard: AISC 341, Chapter J.
2. Backing and tabs removed where required, and placement of weld reinforcing and contouring of fillet welds.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Backing and tabs removed where required, fillet welds added to backing where required, finish of weld tab removal sites, and placement of weld reinforcing and contouring of fillet welds.
   c. Frequency: 100% observation / testing.
3. UT of CJP welds at material ≥ 5/16" for components in seismic force resisting system.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: UT of CJP welds at material ≥ 5/16" for components in seismic force resisting system.
   c. Frequency: 100% observation / testing.
4. MT of Material >1 1/2" loaded in tension through-thickness in tee and corner joints.
   a. Type 5: Fabrication Facility Inspection and Testing for Workmanship.
   b. Criteria: Base material thicker than 1 ½ inches, loaded in tension in the through-thickness direction in tee and corner joints, where connected material is greater than 3/4" thick and contains CJP groove welds.
   c. Frequency: 100% observation / testing. Required where noted as 'TTT' in the drawings.
   d. Standard: AISC 341, Chapter J.
5. MT for cracking in k-areas and at weld access holes.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: MT for cracking in k-areas and at weld access holes.
   c. Frequency: 100% observation / testing.
   d. Standard: AISC 341, Chapter J.
6. MT for beam to column CJP welds.
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: MT for beam to column CJP welds.
   c. Frequency: 25% observation / testing in accordance with AISC 341, Chapter J.
   d. Standard: AISC 341, Chapter J.

3.7 Jobsite Testing and Inspection Requirements for Steel

A. Steel Testing and Inspection Definitions.

1. UT – Ultrasonic Testing.
2. MT – Magnetic Particle Testing.
3. PT – Penetration Testing.
4. SFRS – Seismic Force Resisting System.
5. TTT – Tension Through Thickness.

B. Steel Framing – General.

1. HDAS, HAS, DAS, Threaded studs.
   a. Type 5: Fabrication Facility Inspection and Testing for Workmanship.
   b. Criteria: Review manufacturer certifications for fastener materials.
   c. Frequency: 100% observation / testing.
   d. Standard: AISC 360, Chapter N.
2. MT or PT for thermally cut beam copes and access holes where material ≥2".
   a. Type 5: Fabrication Facility Inspection and Testing for Workmanship.
   b. Criteria: MT or PT for thermally cut beam copes and access holes where material ≥2". Any crack shall be deemed unacceptable regardless of size or location.
   c. Frequency: 100% observation / testing.
   d. Standard: AISC 360, Chapter N.

C. Prior to Bolting.

1. Verify Manufacturer's Certifications
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify manufacturer's certifications available for fastener materials.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
2. Preinstallation bolt testing.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used. Not applicable for snug tight joints.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
3. Verify bolt material, diameter, handling.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify bolt material, diameter, and handling. Verify proper storage for fastener components. Verify fasteners marks in accordance with ASTM requirements.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
4. Verify bolting procedure.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify proper fasteners (grade, type, bolt length if threads are to be excluded from shear plane) and bolting procedure selected for joint detail.
   c. Frequency: (P) Periodic inspection.

d. Standard: AISC 360, Chapter N.

5. Verify connecting element preparation.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify connecting elements meet requirements (if specified), including hole preparation and faying surface condition.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.

D. During Bolting.

1. Verify bolts in all holes.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify fastener assemblies of suitable condition placed in all holes and washers are positioned as required.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
2. Verify bolts positioned as required.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify fasteners placed in all holes and positioned as required.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
3. Installation at pretensioned and slip-critical.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Joint brought in snug-tight condition prior to pre-tensioning, fastener prevented from rotating. Fasteners pretensioned in proper sequence (from the most rigid point toward the free edges). Pretensioned and slip-critical joints using calibrated wrench or turn-of-nut method without matchmarking. Inspector shall be present during installation of fasteners.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N, RCSC Specification.

E. After Bolting.

1. Document acceptance/rejection of joints.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Document acceptance/rejection of bolted connections, member or joint.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.

F. Prior to Welding.

1. Verify welder qualifications and ID system.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Review manufacturer certifications for welding consumables and welding procedure specifications. Verify welder identification system. Note: The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
2. Verify WPS available.

a. Type 1: Material Verification and Workman Certifications.
b. Criteria: Verify Welding Procedure Specification available.
c. Frequency: (C) Continuous inspection.
d. Standard: AISC 360, Chapter N.

3. Verify base material and weld material.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify base material and weld material are in conformance with approved documents.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
4. Verify weld procedures and weld equipment.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify weld procedures and weld equipment are in conformance with approved documents.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
5. Verify joint fit-up, prep, backing, etc.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify fit up of groove welds (including joint geometry) meet requirements for joint preparation, dimensions (alignment, root opening, root face, bevel), cleanliness (condition of steel surfaces), tacking (tack weld quality and location), and backing type and fit (if applicable). Verify fit up of fillet welds meet requirements for dimensions (alignment, gaps at root), cleanliness (condition of steel surfaces), and tacking (tack weld quality and location). Verify configuration and finish of access holes.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.

G. During Welding.

1. Use of qualified welders.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify welder certifications.
   c. Frequency: (P) Periodic Inspection.
   d. Standard: AISC 360, Chapter N.
2. Handling of welding consumables.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify proper control and handling of welding consumables including packaging and exposure control.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
3. No welding over cracked tack welds.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify no welding over cracked tack welds.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
4. Environment conditions (wind/temp, etc.).
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify Welding Procedure Specification is followed for Environment conditions. Verify wind speed, precipitation, and temperature are within limits.

c. Frequency: (P) Periodic inspection.
d. Standard: AISC 360, Chapter N.

5. Verify WPS followed.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify use of qualified welders. Verify Welding Procedure Specification is followed for settings on welding equipment, travel speed, selected welding materials, shielding gas type/flow rate, preheat applied, interpass temperature maintained (minimum and maximum), proper position (F, V, H, OH).
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
6. Welding techniques.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify proper welding techniques for single and multi-pass welds (interpass and final cleaning, each pass within profile limitations, each pass meets quality requirements).
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.

H. After Welding.

1. Verify welds cleaned.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify welds cleaned in accordance with standard.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AISC 360, Chapter N.
2. Verify weld size, length and location.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify weld size, length and location conform to approved documents.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
3. Welds meet visual acceptance criteria.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify welds meet visual acceptance criteria for crack prohibition, weld/base metal fusion, crater cross section, weld profiles, weld size, undercut, and porosity. Where inspector observes questionable welds, non-destructive testing shall be performed.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N, AWS D1.1.
4. Arc strikes.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify no arc strikes are present in the base material. Arc strikes shall be tested using non-destructive methods and repaired if necessary.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
5. Verify no cracking in k-areas and at weld access holes.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: When welding of doubler plates, continuity plate, or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 inches of the weld.
   c. Frequency: (C) Continuous inspection.

d. Standard: AISC 360, Chapter N.

6. Repair activities.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify repair activities conform to standard. Backing and weld tabs removed, and fillet welds added where required.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
7. Document acceptance/rejection of joints.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Document acceptance/rejection of welded joints and/or members.
   c. Frequency: (C) Continuous inspection.
   d. Standard: AISC 360, Chapter N.
8. UT CJP welds, material ≥5/16"
   a. Type 4: Site Testing for Material Properties and Workmanship.
   b. Criteria: Only applies for buildings assigned to Risk Category III or IV. Ultrasonic testing of complete joint penetration groove welds subject to transversely applied tension loading in butt, T- and corner joints, in materials thicker than 5/16”.
   c. Frequency: 100% observation / testing.
   d. Standard: AISC 360, Chapter N.

I. Steel Deck Inspections and Testing - Prior to Deck Placement.

1. Verify deck profile, grade and thickness.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness.
   c. Frequency: 100% observation / testing.
   d. Standard: SDI QA/QC.
2. Document acceptance/rejection of deck.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Document acceptance/rejection of deck and deck accessories.
   c. Frequency: 100% observation / testing.
   d. Standard: SDI QA/QC.
3. Fastener manufacturer installation instructions are available.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify fastener manufacturer installation instructions are available for mechanical fasteners.
   c. Frequency: (P) Periodic inspection.
   d. Standard: SDI QA/QC.
4. Verify proper tools are available for deck installation.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify proper tools are available for deck installation.
   c. Frequency: (P) Periodic inspection.
   d. Standard: SDI QA/QC.
5. Verify deck fastener storage and handling.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify proper storage for mechanical fasteners.
   c. Frequency: (P) Periodic inspection.
   d. Standard: SDI QA/QC.

J. Steel Deck Inspections and Testing - During Deck Installation.

1. Verify deck type and layout.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify deck type and layout conforms to approved documents.
   c. Frequency: (P) Periodic inspection.
   d. Standard: SDI QA/QC.
2. Verify deck fastening (PAF / Screws / Welds) type, size, spacing and layout.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify deck fastening (PAF / Screws / Welds) type, size, spacing and layout conform to approved documents.
   c. Frequency: (P) Periodic inspection.
   d. Standard: SDI QA/QC.
3. Verify fasteners are installed per manufacturer instructions and are fully seated.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify fasteners are installed per manufacturer instructions and are fully seated and positioned correctly.
   c. Frequency: (P) Periodic inspection.
   d. Standard: SDI QA/QC.
4. Welding requirements - See welding requirements in Structural Steel.
   a. Type: See welding requirements in Structural Steel.
   b. Criteria: See welding requirements in Structural Steel.
   c. Frequency: See welding requirements in Structural Steel.
   d. Standard: See welding requirements in Structural Steel.

K. Steel Deck Inspections and Testing - After Deck Installation.

1. Verify compliance of deck and deck accessories.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify compliance of deck and deck accessories comply with construction documents. Verify deck materials are represented by the mill certifications that comply with the construction documents.
   c. Frequency: 100% observation / testing.
   d. Standard: SDI QA/QC.
2. Verify support and sidelap connection type, size, spacing and layout.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Check spacing, type, diameter, and installation of support, sidelap, and perimeter fasteners. Verify screws adequately penetrate base material (3 threads min). Verify repair activities. No popped screw heads or stripped screws are permitted. All damage screws shall be replaced. Verify PAF's are fully driven.
   c. Frequency: 100% observation / testing.
   d. Standard: SDI C, SDI NC, SDI RD, ICC-ES Reports.
3. Inspect connection installation.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify connection installation conforms to standard.
   c. Frequency: 100% observation / testing.
   d. Standard: SDI QA/QC, SDI C, SDI NC, SDI RD, ICC-ES Reports.
4. Document acceptance/rejection of deck connections.
   a. Type 2: Site Inspection for Layout and Quantities.

b. Criteria: Document acceptance/rejection of deck, accessories, and connections. Verify materials have been drawn together.
c. Frequency: 100% observation / testing.
d. Standard: SDI C, SDI NC, SDI RD.

3.8 Jobsite Testing and Inspection Requirements for Cold Formed Steel

A. Framing.

1. Members and connections.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify type, size, location, spacing.
   c. Frequency: (P) Periodic inspection.
2. Bridging and blocking layout and connections.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify type, location, and attachment.
   c. Frequency: (P) Periodic inspection.
3. No field cuts / notches through flanges.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: No cuts or notches through section flanges permitted.
   c. Frequency: (P) Periodic inspection.
4. No member splices except where shown.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: No splicing of structural members permitted unless specified on the construction documents.
   c. Frequency: (P) Periodic inspection.
5. Punchouts are away from bearings/connections.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify spacing requirements from bearings and connections and reinforcing is used where required.
   c. Frequency: (P) Periodic inspection.
6. Studs seated in tracks per details.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify stud seated tightly within the top and bottom track with gap not exceeding permitted dimension, where gap is exceeded verify shims are provided.
   c. Frequency: (P) Periodic inspection.
7. Floor/roof framing aligned with studs.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify framing is aligned over a bearing stud within permitted dimension
   c. Frequency: (P) Periodic inspection.

B. Welded Attachments.

1. Procedures, materials, qualifications.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify filler materials, welding procedures, welder qualifications, and manufacturer's certificate of compliance.
   c. Frequency: 100% observation / testing.
   d. Standard: AWS D1.1/D1.3.

2. During welding.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify welds type, size, layout, and procedure are in accordance with the approved documents.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AWS D1.3.
3. After welding.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify welds type, size, layout, and procedure are in accordance with the approved documents.
   c. Frequency: (P) Periodic inspection.
   d. Standard: AWS D1.3.
4. Corrosion resistance treatment.
   a. Type 3: Site Inspection for Procedures and Workmanship.
   b. Criteria: Verify welded areas are treated with approved treatment to match corrosion resistance of effected area.
   c. Frequency: (P) Periodic inspection.

C. Screwed Attachments.

1. Type, diameter, length, spacing, edge distance.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify type, diameter, length, spacing, and edge distance are installed in accordance with the approved documents. Verify installation is in conformance with ICC-ES Report.
   c. Frequency: (P) Periodic inspection.
   d. Standard: ICC-ES Report.
2. Penetration.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify screws are fully driven with a minimum penetration of 3 threads through the last material joined.
   c. Frequency: (P) Periodic inspection.
3. Connected materials drawn together.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify connected materials have been drawn together.
   c. Frequency: (P) Periodic inspection.
4. No popped screw heads/stripped threads.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: No popped screw heads/stripped threads are permitted. All damaged screws shall be replaced.
   c. Frequency: (P) Periodic inspection.

D. Power-Actuated Fasteners.

1. Type, diameter, length, spacing, edge distance.
   a. Type 2: Site Inspection for Layout and Quantities.
   b. Criteria: Verify type, diameter, length, spacing, finish, base material, and edge distance are installed in accordance with the approved documents. Verify connected materials have been drawn together.

c. Frequency: (P) Periodic inspection. First of each fastener type and base material type.

2. Conformance with ICC-ES Report.
   a. Type 1: Material Verification and Workman Certifications.
   b. Criteria: Verify installation is in conformance with ICC-ES Report.
   c. Frequency: (P) Periodic inspection.
   d. Standard: ICC-ES Report.

END OF SECTION 014010

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary Controls: Barriers, enclosures, and fencing.

B. Security requirements.

C. Waste removal facilities and services.

1.02 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.03 FENCING

A. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.04 SECURITY - See Section 013553

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.05 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transportation, handling, storage and protection.

B. Product option requirements.

C. Substitution limitations.

1.02 RELATED REQUIREMENTS

A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

C. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:

C. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 016116.

2. If wet-applied, have lower VOC content, as defined in Section 016116.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Cutting and patching.

C. Surveying for laying out the work.

D. Cleaning and protection.

E. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
1. On request, submit documentation verifying accuracy of survey work.
2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
3. Submit surveys and survey logs for the project record.

C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
1. Structural integrity of any element of Project.
2. Integrity of weather exposed or moisture resistant element.
3. Efficiency, maintenance, or safety of any operational element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate Contractor.

1.04 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

1.05 PROJECT CONDITIONS

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and _____.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations, and _____.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.

7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

F. Restore work with new products in accordance with requirements of Contract Documents.

G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.

I. Patching:
1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.06 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.09 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.10 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

END OF SECTION

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.

E. Methods of trash/waste disposal that are not acceptable are:
1. Burning on the project site.
2. Burying on the project site.
3. Dumping or burying on other property, public or private.
4. Other illegal dumping or burying.
5. Incineration, either on- or off-site.

F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.

b. Amount, in tons or cubic yards (cubic meters), of trash/waste material from the project disposed of in landfills.
c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

4. Recycled and Salvaged Materials: Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on other projects.
   b. Amount, in tons or cubic yards (cubic meters), date removed from the project site, and receiving party.
   c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
5. Material Reused on Project: Include the following information for each:
   a. Identification of material and how it was used in the project.
   b. Amount, in tons or cubic yards (cubic meters).
   c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. Provide containers as required.
   2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Materials transparency manual.

1.02 RELATED REQUIREMENTS

A. Individual Product Sections: Specific requirements for operation and maintenance data.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

END OF SECTION

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building demolition excluding removal of hazardous materials and toxic substances.

B. Selective demolition of built site elements.

C. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 003100 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.

B. Section 011000 - Summary: Limitations on Contractor's use of site and premises.

C. Section 011000 - Summary: Sequencing and staging requirements.

D. Section 011000 - Summary: Description of items to be removed by Owner.

E. Section 011000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.

F. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

G. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.

H. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

I. Section 312200 - Grading: Rough and fine grading.

J. Section 312323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

PART 3 EXECUTION

2.01 DEMOLITION

A. Remove other items indicated, for salvage, relocation, recycling, and _____.

B. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 312200.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   5. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   6. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

2.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Remove existing work as indicated and required to accomplish new work.
   1. Remove items indicated on drawings.

C. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

D. Protect existing work to remain.

1. Prevent movement of structure. Provide shoring and bracing as required.
2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch to match new work.

2.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 030124 - UNBONDED POST-TENSIONING REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This section includes repair to unbonded post-tensioning in the slabs and beams as follows:

1. Repairing damaged tendon sheathing.
2. Splicing of damaged or broken post-tensioning strand.
3. Repairing damaged or deteriorated anchorages.
4. Extraction and threading of post-tensioning strand.
5. Stressing of repaired post-tensioning tendons.

1.3 SUBMITTALS

A. Product Data: As per ACI 423.7 – Specification for Unbonded Single-Strand Tendon Materials, and PTI M10.3 - Field Procedures Manual for Unbonded Single Strand Tendons:

1. Couplers
2. Center stressing couplers
3. New anchorage systems
4. Temporary troubleshooting or lock-off anchors/devices
5. Post-tensioning coating
6. Tendon sheathing
7. Anchorage devices
8. Bar and tendon supports
9. Pocket formers
10. Sheathing repair products
11. Stressing-pocket patching material
12. Encapsulation system

B. Certified mill test reports for each pack of strand, containing as minimum the following information: as per ACI 423.7.

1. Coil numbers or identification.
2. Breaking load.
3. Load at 1 percent extension.
4. Elongation at failure.
5. Modulus of elasticity.

6. Diameter and net area of strand.

C. Tendon test results: as per ACI 301 – Specifications for Structural Concrete and ACI 423.7.

D. Plan for safety precautions during prestressing steel detensioning and stressing.

E. Product information and installation procedures for splicing/coupling and stressing the prestressing steel.

F. PT installation drawings and stressing calculations, including tensioning forces, wobble and curvature friction coefficients and anchor set, and calculated elongations.

G. Qualification Data: For Installer. Include resume of individual supervising installation and stressing of post-tensioning tendons.

H. Stressing Jack Calibration: Calibration certificates for jacks and gages to be used on Project. Calibrate each jack-and-gage set as a pair.

I. During construction, submit the following to the Engineer:

1. Keep stressing records and submit to Engineer. Forward completed stressing record forms to the Engineer for review and approval prior to cutting the strand tails, or encasing the coupler, center stressing coupler, or stressing anchorage. Record on each report:
   a. Name of project.
   b. Name and signature of inspector.
   c. Name of individual in charge of stressing operation.
   d. Calculated elongation.
   e. Actual measured elongation at each stressing location.
   f. Calculated gauge reading to achieve required jacking force using actual jacking calibration certificate at each tendon.
   g. Actual gauge reading and jacking forces at each stressing location.
   h. Range of allowable elongations for stressing force.
   i. Serial or identification number of stressing equipment used at each stressing location.
   j. Date of stressing operation.
   k. Location or designation of tendons being repaired.

1.4 CLOSEOUT SUBMITTALS

A. At the conclusion of construction, submit as-built drawings to the Engineer showing the locations and types of repairs performed to the post-tensioning system.

1.5 QUALITY ASSURANCE

A. Post-Tensioning Contractor Qualifications: Unless otherwise specified, Post-tensioning Contractor shall have a minimum of five years' experience in post-tensioning tendon repair on projects of similar scope and size and have completed a minimum of 5 projects of similar scope and size in the past 10 years.

B. Field Personnel Qualifications: Field Personnel, which consists of Installation and Tensioning crews, shall be trained and certified in post-tensioning tendon repair by the Post-Tensioning Institute (PTI) or an otherwise approved independent training and certification program, as provided in 1.5.C through 1.5.E, unless alternate qualifications are accepted by the Engineer.

C. Both the Field Installation and Field Tensioning crew foreman must have PTI Level 2 Unbonded PT Installer or Inspector, PTI Level 2 Unbonded PT Repair, Rehabilitation, & Strengthening.

D. At least 50 percent of Installation Field Personnel must have PTI Level 1 Unbonded PT Installation certification, PTI Level 1 Unbonded PT Repair, Rehabilitation, & Strengthening, or higher.

E. At least 50 percent of Tensioning Field Personnel must have PTI Level 2 Unbonded Installer or Inspector, PTI Level 2 Unbonded PT Repair, Rehabilitation, & Strengthening, and the remaining portion of the Tensioning Field Personnel having PTI Level 1 Unbonded PT Field Installation, PTI Level 1 Unbonded PT Repair, Rehabilitation, & Strengthening.

F. Manufacturer Qualifications: Fabricating plant certified by PTI according to procedures set forth in PTI's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."

G. Testing Agency Qualifications: An independent agency retained by the Owner and qualified according to ASTM E 329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection for testing indicated, as documented according to ASTM E 548 - Standard Guide for General Criteria Used for Evaluating Laboratory Competence.

1. Testing Agency Inspector: Personnel performing field inspections and measuring elongations shall have successfully completed PTI's Level 1 - Field Fundamentals course or shall have equivalent qualifications acceptable to Engineer.

H. Source Limitations: Obtain post-tensioning materials and equipment from the same supplier.

1. Stressing jacks not provided by post-tensioning supplier must be calibrated and approved for use on Project by post-tensioning supplier.

I. Post-Tensioning Tendon Installer Field Personnel Qualifications:

1. On-site superintendent shall have supervised 5 projects of similar magnitude and design and be acceptable to Engineer. Submit the following:
   a. Name and address of project.
   b. Contact information for reference person for project.
   c. Brief description of structure system and work performed.
   d. Scope and size of project.
   e. Date completed.

J. Mockups

1. Install couplers and splicing hardware at repair location to verify that they will work as intended. Minimize damage to concrete.
2. Adjust couplers and splicing hardware as necessary, at no cost to owner.
3. Owner’s Representative and Engineer will observe and approve mockup.

1.6 DELIVERY, HANDLING, AND STORAGE

A. Deliver, store, and handle post-tensioning materials according to PTI M10.3.

B. Inspect new tendons and accessory items at time of their delivery to Project site before unloading and reject damaged or corroded tendons. Any damage to the encapsulated system, such as sheathing tears or cuts (beyond that specified as repairable), sheathing withdrawn from connecting sleeves, or connecting sleeves withdrawn from fixed anchorages shall be cause for repair or rejection by Installer or Engineer.

C. Inspect sheathing before installation as per PTI M10.3.

D. Keep accurate and current records of materials delivered and used.

PART 2 - PRODUCTS

2.1 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A 416/A 416M, Grade 270, uncoated, 7-wire, low-relaxation, 0.5-inch diameter strand.

B. Post-Tensioning Coating (Grease): Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties specified in ACI 423.7; chemically stable and nonreactive with prestressing steel, nonprestressed reinforcement, sheathing material, and concrete.

1. Minimum Coating Weight: 2.5 lb for 0.5-inch diameter strand per 100 feet of strand.
2. Completely fill annular space between strand and sheathing over entire tendon length with post-tensioning coating.

C. Tendon Sheathing: Comply with ACI 423.7.

1. Minimum Thickness: 0.050 inch for polyethylene or polypropylene with a minimum density of 0.034 lb/cu. in.
2. Continuous over the entire length of tendon to provide watertight encapsulation of strand and between anchorages to prevent intrusion of cement paste or loss of coating for a non-encapsulated system.

2.2 AUXILIARY MATERIALS

A. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler or center-stressing coupler complying with static and fatigue testing requirements in ACI 423.7 and capable of developing 95 percent of actual breaking strength of strand.

1. Anchorage Bearing Stresses: Comply with ACI 423.7 for stresses at transfer load and service load.

2. Fixed-End Anchorage Device Assemblies: Plant fabricated with wedges seated at a load or backstress of not less than 80 percent and not more than 85 percent of breaking strength of strand.
3. Couplers and Center-Stressing Couplers: Designed for and compatible with the tendon system.
4. Existing Anchorages: Where possible, existing anchorage castings/plates may be used with new wedges with the approval of the Engineer. New wedges shall be fully compatible with existing anchors and tested according to ACI 423.7. Wedges shall preclude premature failure of prestressing steel due to notch or pinching effects under the test load conditions stipulated in ACI 423.7.

B. Encapsulation System: Watertight encapsulation of prestressing strand consisting of the following:

1. Wedge-Cavity Caps: Attached to anchorages with a positive mechanical connection and completely filled with post-tensioning coating.
   a. Caps for Fixed and Stressing-End Anchorages Devices: Designed to provide watertight encapsulation of wedge cavity. Sized to allow required extension of strand past the wedges.
      1) Attach cap for fixed-end anchorage device in fabricating plant.

   b. Caps at Intermediate Anchorages: Open on end to allow passage of strand.

2. Sleeves: Attached to anchorage device with positive mechanical connection; overlapped a minimum of 4 inches with sheathing and completely filled with post-tensioning coating.

C. Sheathing for Repair at Existing Prestressing Steel:

1. Watertight, chemically stable, and nonreactive with prestressing steel, PT coating, and reinforcing steel.
2. Color shall contrast with PT coating so that sheathing tears will be readily visible. Polypropylene or polyethylene tubing:
   a. Minimum thickness of 0.050 in.
   b. Inside diameter at least 0.030 in. greater than prestressing steel diameter.
   c. Slit tubing longitudinally for sheathing repairs at continuous prestressing steel.

D. Protection for Couplers and New Center Stressing Couplers:

1. If coupler is not already fully encapsulated, install protection for couplers and central stressing couplers to provide watertight enclosure, such as heat-shrink tubing or rigid high-density polyethylene (HDPE) plastic pipe, to encapsulate couplers and splicing hardware.
2. Heat-shrink tubing shall be: watertight, chemically stable, and nonreactive with prestressing steel, PT coating, and reinforcing steel.
3. Coupler encapsulation method must allow for tendon elongations to freely occur and not impede or bind coupler.

E. Protection at New End and Intermediate Anchorages:

1. If the anchorages are not already coated with plastic, field apply epoxy coating to all surfaces of wires, plates, anchor washers, etc. at locations of end and intermediate anchorage and center stressing couplers.

F. Specialty Sheathing Repair Tape: Self-adhesive, moisture-proof, nonreactive with sheathing, coating, or prestressing steel, have elastic properties, have a minimum width of 2 in. (50 mm), have a contrasting color to the tendon sheathing. Use one of the following or approved equal:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Adhesive Tape Products, Inc.; PWT-20.
   b. 3M; Tape 226.
   c. Tyco Adhesives; Polyken 826.

G. Concrete patch material at Stressing Pocket: One component, polymer-modified, nonmetallic, non-shrink, premixed patching material containing selected silica aggregates and portland cement, suitable for vertical and overhead application. Do not use material containing chlorides or other chemicals known to be deleterious to prestressing steel or material that is reactive with prestressing steel, anchorage device material, or concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Euclid Chemical Company (The); Verticoat Supreme.
   b. Kaufman Products, Inc.; Patchwell V/O.
   c. MAPEI USA; Planitop XS.

H. Concrete patch material to maintain tendon profile:

1. See Concrete Repair Notes on drawings.

2.3 EQUIPMENT

A. Stressing Equipment: Hydraulic stressing jacks calibrated with a pressure gauge shall be capable of gripping prestressing steel and be capable of stressing the prestressing steel to the specified force. Maintain equipment in safe, working condition.

1. Provide calibrated stressing equipment with means to cross-check accuracy constantly.
2. Provide current (not to exceed 6 months) jack calibration for each jack relating the gauge pressure reading to the jacking force.
3. Exercise care in handling of stressing equipment.

B. Necessary equipment to detension, cut, and splice/couple prestressing steel.

C. All equipment is to be operated and maintained according to the manufacturer's recommendations or the approved testing procedures.

PART 3 - EXECUTION

3.1 SAFETY PRECAUTIONS

A. Prestressing steel under stress has significant stored energy. Exercise care in concrete removal, detensioning, and stressing.

1. Erect and maintain work platforms in safe condition, in conformance with Government regulations.
2. Protect areas around, adjacent to, and below work area, including vehicular traffic, from damage.
3. Protect construction personnel and passersby from injury.
   a. Do not allow anyone to stand in front of, behind, over, or beneath hydraulic jack, or anywhere along the tendon during stressing or detensioning of the prestressing steel.
   b. During stressing and detensioning, particularly after stressing, when releasing jack to transfer force to wedges, operators' hands shall be kept clear of jack or jacking assembly.
4. Close off area around, adjacent to, and below work area or use canopies and barriers as necessary to protect public.
5. Detensioning shall be performed by experienced personnel by Engineer approved cutting method, preferably while tendon is still embedded in concrete, by use of specialty detensioning equipment, or by other approved means.

B. Comply with safety plan submitted in accordance with Paragraph 1.3D.

3.2 PREPARATION

A. Prior to concrete removal, locate prestressing steel using nondestructive testing (NDT) methods at locations as shown on the contract documents, or by other approved means. Tendons may occur individually or in bundles.

B. Identify and clearly mark visibly fractured, corroded, or otherwise damaged sections of prestressing steel. Create exploratory openings in concrete as necessary to locate fractured or corroded sections. Engineer will inspect tendon and determine appropriate repair method before replacement. If there are areas of the prestressing steel that are not fractured or severely corroded, the tendon may be repaired by splicing in sections of new prestressing steel. Refer to Paragraph 3.3.

C. Prior to beginning concrete removal or tendon repair, install shoring and/or sequence repairs as directed by the Engineer. This shoring must be designed by an Engineer competent in shoring design and licensed in the state for the Authority having Jurisdiction.

D. Remove unsound concrete per the Contract Documents. Exercise care to avoid damaging prestressing steel, sheathings, anchorages, and remaining sound concrete. Do not remove concrete at post-tensioning anchorages or within 4'-0" of anchorages unless directed to do so by the Engineer.

E. Stage work, as necessary, to maintain tendon profile.

F. Identify damaged sheathing and document locations.

3.3 SPLICING PRESTRESSING STEEL FOR PARTIAL REPLACEMENT

A. Repair fractured or severely corroded strand at the locations determined by the Engineer by splicing in sections of new prestressing steel similar in kind, tensile strength, and size.

B. Detension prestressing steel as necessary by cutting, preferably while still embedded in concrete, heating, by the use of specialty detensioning equipment, or by other preapproved means. Where detensioning of only a portion of the tendon length is desired, install troubleshooting lock-off anchor at locations determined by Engineer.

C. Remove concrete as required to expose sufficient length of prestressing steel that is not deteriorated on both sides of deteriorated prestressing steel section, and to permit installation of coupler hardware allowing adequate room for movement of the coupler during stressing of the prestressing steel. Exercise care to avoid damaging remaining sound concrete and sheathing. All excavated areas shall be square or rectangular in shape with 90-degree corners. Mechanically roughen all vertical and horizontal surfaces of the excavated area to 1/4” amplitude.

   1. See Concrete Repair Notes on drawings.

D. If prestressing steel has a vertical deviation (drape/profile) or horizontal deviation (sweep) in the area of concrete removal, discuss method of removing prestressing steel with Engineer. Maintain the design tendon drape/profile and sweep.

E. Remove deteriorated or damaged section of prestressing steel. Keep all removed post-tensioning and reinforcing materials (anchors, strand, bars, etc.) separated and marked by location for engineer review.

F. Discuss splicing procedure with Engineer to ensure that remaining concrete is not overstressed during stressing.

G. Form as necessary and cast concrete repairs that are necessary for stressing prestressing steel.

   Do not stress prestressing steel until repair concrete has achieved at least 5000 psi or as approved by the Engineer. Prepare the exposed prestressing steel per Paragraph I as follows.

H. If replacing end anchorage, install new end anchorage and repair concrete per the Contract Documents. Provide new wedges and hardware compatible with new anchor.

I. Install coupler materials.

   1. Pull ends of existing prestressing steel taut.
   2. Install couplers and/or central stressing couplers with new section of prestressing steel.
   3. New sheathing may need to be placed on the tendon during splicing operations.

J. Prepare existing prestressing steel.

1. Coat exposed existing prestressing steel with PT coating.
2. Install split-tube sheathing over existing prestressing steel, and wrap with sheathing repair tape as described in Paragraph 3.4.

K. Repair sheathing at couplers (and center stressing couplers) as per Paragraph 3.4I.

L. Ensure couplers and center-stressing couplers are free to move during stressing operations and do not bind on other reinforcing steel or PT tendons. Install temporary plastic slip sheets for separation, if necessary, and remove after stressing is completed.

M. Stress tendon per Paragraph 3.5.

N. When stressing operation has been completed and after tendon force verification, prepare repair openings and form and cast repair openings with acceptable repair product.

1. Inspect anchorage for correct installation.
2. Inspect sheathing for damage and for continuous seal between sheathing and anchor.
   a. Repair sheathing damage to watertight condition.
   b. Do not leave tendons and repair area exposed to weather without protection prior to concrete placement. The Installer shall propose to the Engineer the plan to guarantee a full protection of the PT system against exposure to weather.
3. Apply PT coating to exposed prestressing steel, including strand tails at anchorages, and restore sheathing as per Paragraph 3.4.
4. Install protection for couplers and central stressing couplers to provide watertight enclosure per Paragraph 3.4I. If heat-shrink tubing is used, shrink heat-shrink tubing into position to encapsulate prestressing steel. Seal ends of new sheathing with repair tape.
5. Remove rust from exposed prestressing steel using light sandblasting or steel brush.
6. Coat other exposed steel with steel primer per the Contract Documents.
7. Install reinforcing dowels into sides of full-depth repair openings as required, anchoring with adhesive per the Contract Documents.
8. Add supplemental reinforcement as directed by the Engineer.
9. See Paragraph 3.5E for cutting of strand tails and end cap encapsulation requirements.

3.4 SHEATHING REPAIR

A. At locations of damaged sheathing, remove concrete to expose sheathing at least 6 in. beyond damaged portion and to create space between the sheathing and the concrete. Exercise care to avoid further damage to sheathing. Minimize concrete removal around a stressed tendon where the profile of the tendon may be affected.

B. At small, localized areas of sheathing damage, as determined by the Engineer:

1. Remove rough portions of existing sheathing at damaged area.
2. Fill sheathing with PT coating.
3. Clean and prepare surface of existing sheathing per repair tape manufacturer's recommendations. Outer surface of sheathing shall be dry and free of PT coating.

4. Tape damaged area of sheathing. Wrap specialty sheathing repair tape spirally around sheathing to provide at least 2 layers of tape at all locations. Extend repair tape at least 3 in. beyond damaged area.

C. Remove damaged portion of sheathing.

D. Remove rust from exposed prestressing steel using light sandblasting or steel brush. Protect existing sheathing from damage.

E. Coat exposed prestressing steel or pressure-inject with PT coating. PT coating must extend to, but not cover, 6 in. of intact existing sheathing at ends of the exposed portion of sheathing.

F. Clean and prepare the existing sheathing per repair tape manufacturer's recommendations. At a minimum, the surface of the sheathing shall be dry, clean, and free of PT coating.

G. Install new split tubing.

For sheathing repairs where split tubing of sufficient width to be placed around the entire circumference of the prestressing steel is available.

1. Wrap split tubing around prestressing steel to provide a continuous layer over prestressing steel and PT coating. Position edges of tubing with shingle overlap (that is, with upper portion overlapping lower portion).
2. Extend new split tubing at least 3 in. (76 mm) over existing sheathing.
3. Wrap specialty repair tape spirally around split tubing to provide at least 2 layers of tape at all locations. Extend repair tape at least 3 in. (76 mm) onto existing sheathing.

H. Install new overlapping tendon sheathing.

For sheathing repairs where split tubing does not completely cover the strand, where repair tape is used in place of split tubing or to repair cracked sheathing.

1. Place two pieces of overlapping tendon sheathing around prestressing steel. Position with shingle overlap (that is, with upper portion overlapping lower portion).
2. Extend new overlapping tendon sheathing at least 3 in. (76 mm) over existing sheathing.
3. Tape new overlapping tendon sheathing. Wrap repair tape spirally around sheathing to provide at least 2 layers of tape. Extend repair tape at least 3 in. (76 mm) onto existing sheathing.

I. Protection of Couplers and Center Stressing Couplers

1. Unless supplied with encapsulation, protect all new couplers in a watertight enclosure. If heat-shrink tubing is used to provide watertight enclosure, place heat-shrink tubing over coupler, central stressing coupler, or tendon during assembly of spliced tendon repair. Do not shrink tubing into final position until stressing is completed. Shrink tubing using a heat gun as approved by the Engineer; open flames shall not be permitted. Provide 3 in. minimum overlap with sheathing for adjacent section of tendon.
2. All new encapsulated center stressing couplers shall be supplied fully encased in protective plastic cover with plastic encapsulation caps to provide for full encapsulation of center stressing coupler.

J. Protection of Anchorages

1. All new end anchor castings shall be supplied fully encased in protective plastic cover, with plastic trumpet and plastic-covered encapsulation cap, to provide for full encapsulation of the new anchor.
2. For hardware that is not encapsulated or protected by heat-shrink tubing: Before stressing, coat elements with epoxy that will become inaccessible after stressing, except the portions of those elements that must remain uncoated for stressing operations. After stressing, coat exposed elements with epoxy that are not already coated, and repair previous coating that was damaged.

K. Sheathing repairs shall restore the continuity of the sheathing and be approved by the Engineer.

3.5 STRESSING PRESTRESSING STEEL

A. Exercise care in handling stressing equipment to maintain accuracy of calibration.

B. Before stressing, verify that prestressing steel is free-moving along its length, including at couplers. Orient wedges in the wedge cavity such that the seating plunger of the jack engages both wedge sections perpendicular to the jack position during stressing.

C. The stressing record forms with theoretical elongation and gauge pressure shall be available for use by the stressing crews and project inspectors whenever stressing is initiated.

D. Stress tendon to jacking force as shown on drawings at lock-off with hydraulic jack.

1. Calculate elongation for specified jacking force for each tendon.
2. Sequence stressing as necessary.
3. Remove slack from system prior to marking tendon for elongation measurements. This can be completed by jacking strand to 20% of final gauge pressure and lifting off.
4. Monitor hydraulic pressure and convert the jacking force to a gauge reading using the jack calibration chart.
5. When specified jacking force has been attained, anchor prestressing steel with wedges.
6. Measure prestressing steel elongation and compare with calculated elongation. If difference is more than ±10%, notify the Engineer for direction. Measurements to be taken to a ¼” precision, use thin marking lines to allow for precision to be maintained.
7. If required, perform lift off test after stressing and in presence of Engineer after stressing and setting of wedges. Only one lift off test is allowed after full stress force is applied. If additional lift off is needed, the prestressing strand will need to be replaced.
8. Complete stressing records during stressing operations.

E. After Engineer has accepted stressing records, prepare repair openings for concrete or repair mortar placement.

1. Cut off strand tails of prestressing steel using method approved by Engineer. Do not flame cut unless specifically approved by Engineer as damage may occur if flame cutting specific components and accessories are not installed. Plasma cutting or cut-off shearing of strand tails is preferred.

2. Clean prestressing steel, anchorages, and stressing pockets of PT coating. Use noncorrosive solvent.
3. Cut end of prestressing steel within stressing pocket, providing for at least 0.75 in. of concrete cover to the strand tail or 1 in. to the encapsulation components. Strand tails should be cut to a length which allows proper seating of encapsulation cap.
   a. Do not damage prestressing steel, anchorage, or concrete. Leave prestressing steel end clean and free of burrs.
   b. Do not cut strand tails less than 0.5 in. (13 mm) from the face of the anchor casting.
4. Install encapsulation cap on cut ends at encapsulated components.
5. Tendon tails shall be accessible for inspection prior to and during cutting, and prior to placement of protective caps and concrete patching material.
6. Roughen or prime interior of stressing pocket and install approved patch material, strike flush with surrounding concrete. Grind off any rough or overpoured areas.
7. See Concrete Repair Notes on drawings.

3.6 FIELD QUALITY CONTROL

A. Installer shall:

1. Complete stressing records during retensioning operations and submit to the Engineer for review and verification per the requirements of PTI M10.3.
2. Review tendon installation. Repair or replace nonconforming work.
3. Do not cut PT strand tails until written or verbal approval is provided by Engineer.

B. Engineer or testing agency retained by Owner will inspect installed Work prior to concrete placement. Items include:

1. Prestressing steel size, spacing, and cover.
2. Tendon profile and sweep.
3. Type and condition of sheathing, including damage and repairs.
4. Condition of anchorages and splicing hardware.

END OF SECTION 030124

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Footings.
2. Foundation walls.
3. Floor and slabs on grade.
4. Concrete curing.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. See Section 01 30 00 – Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Submit substantiating data for each concrete mix design contemplated for use to the Architect no less than four weeks prior to first concrete placement. Data for each mix shall include the following:
   a. Mix identification number (unique for each mix submitted).
   b. Statement of intended mix use.
   c. Mixture proportions.
   d. Documentation of the method and test data used to establish mixture proportions.
   e. Water/cementitious materials ratio.

f. Wet and dry unit weight.
g. Total air content.
h. Design slump and allowable range after additions of all admixtures.
i. Time limits on discharge: If time of discharge exceeds ACI 301 90-minute time limit, submit concrete properties criteria at permissible time of discharge and additional special inspection and testing requirements associated with time limits.
j. Compressive strength tests.

3. Before submitting concrete design mixtures to the architect for review, contractor shall review concrete design mixture for applications, state on the submittal where the concrete mix will be used, establish procedures for ensuring quality of concrete materials and verify suitability of mix design for placement and finishing.

D. Steel Reinforcement Shop Drawings: Submit placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Show all reinforcing, top and bottom profile of concrete element, supports below, including beams, columns and walls, grade beams, concrete walls, joists, etc. framing into element.
2. Provide one continuous elevation at 1/4-inch (1:48) scale for all beams, joists or walls in a continuous line. Show pockets and openings in shear walls, structural slabs, beams, elevations of top of beams, walls, columns, sections through beams, pilasters, columns, and placing sequence of reinforcing for items with more than one reinforcing layer.
3. Show locations of approved construction joints, locations of pour strips, splices of reinforcing, type of splice used and splice location. Identify all ASTM A706 and epoxy coated reinforcing locations.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of Architect.

F. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.
7. Repair materials.
8. Supplementary Cementitious materials.

G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates: Submit test reports indicating that aggregates are not potentially reactive based on the ASTM C295 or ASTM 1260 testing limits set forth in section 5.1 of “Guide

Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). Alternatively, submit ASTM C1567 test reports indicating that the combination of mix ingredients reduces the expansion due to Alkali aggregate reactivity such that the mix complies with section 5.2 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). All tests for submitted reports shall have been performed within one year of the submittal date.

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

I. Minutes of preinstallation conference.

J. Placement Notification: Submit notification to Architect at least 24 hours in advance of placement.

K. Certification of chloride screen effectiveness for penetrating sealers.

L. Proposed location of saw cut joints not indicated on Drawings.

M. Curing compound data demonstrating specified moisture loss performance.

N. Evaporative retarder product and application data.

O. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work

P. 1. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 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.

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

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
3. Personnel inspecting concrete reinforcing steel have current certification as an ACI Concrete Construction Inspector or have experience in concrete construction acceptable to the Architect.

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

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

E. Formwork: Contractor shall be responsible for design and engineering of formwork. Design of formwork and preparation of formwork drawings shall be performed under supervision of a qualified engineer registered in the state of the project.

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

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Preinstallation Conference: Conduct conference at Project site or by video conference call.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Ready-mix concrete manufacturer.
   c. Concrete subcontractor.
   d. Special concrete finish subcontractor.
   e. Owner’s Testing/Inspection Agency.

2. Review as applicable to Project special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, concrete protection, field sampling procedures for concrete cylinders and air testing, initial curing and field curing of field test cylinders (ASTM C31/C31M), protection of field cured field test cylinders.
3. Minutes of the meeting shall be recorded by Contractor and distributed to all parties within five days. Provide one copy to Owner’s representative and Architect.

H. Record of Work: Maintain a record listing time and date of all structural concrete placement. Such record shall be kept until completion of Project and shall be available to Architect for examination at any time.

I. Pre-Placement Inspection: Formwork installation, reinforcing steel placement and installation of all items to be embedded or cast into concrete shall be verified by Contractor prior to placement.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement if present.

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.

1. Plywood, metal, or other approved panel materials.

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.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 1/2-inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Total recycled content not less than 95 percent.

B. All steel reinforcement shall be produced using an electric arc furnace.

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

D. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed, where welding of reinforcement or field bending is noted on Drawings.

E. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 ASTM A 706/A 706M for bars that may be field bent, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M for bars that are prefabricated, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

F. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

G. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

H. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

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," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

D. Mechanical Connectors: Mechanical couplers shall develop in tension or compression, as required, at least 125% of bar yield strength. Connectors shall comply with ICC-ES acceptance criteria, ACI 133.

2.4 CONCRETE MATERIALS

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

1. Ordinary Portland Cement: ASTM C 150, Type as indicated on drawings, gray. Alternate cementitious materials when proposed to control alkali-silica reactions and tested as part of a representative concrete mix in accordance with ASTM C1567, may be used subject to approval.

2. Blended Hydraulic Cement: ASTM C 595, Type IL, portland-limestone cement.

3. Supplementary Cementitious Materials (SCM): Of proportions and type to meet concrete performance criteria as indicated in the structural drawings. Available SCM's that may be incorporated into the Work include, but are not limited to, the following:
   a. Fly Ash: ASTM C 618, Class F or C
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
   c. Silica Fume: ASTM C 1240, amorphous silica.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. All coarse and fine aggregate shall be tested per ASTM C 295 or ASTM C 1293 in accordance with section 5.1 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association).

   1. Maximum Coarse-Aggregate Size:-As indicated on Drawings.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable or ASTM C 1602 tested non-potable which is compatible with admixtures.

2.5 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.

   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
   7. Mid-Range Water Reducing Admixture: ASTM C 494/C 494M, Type A.
   8. Carbon Dioxide Mineralization: ASTM C494 Type S.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

   1. VOC Content: Evaporation retarders shall have a VOC content of 780 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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

a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

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

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Film must chemically break down in a four to six week period. Membrane-Forming Curing Compounds shall have a VOC content of 350 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Curing and sealing Compounds shall have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Class A. Curing and sealing Compounds shall have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.8 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Supplementary Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement while meeting the embodied carbon limits listed on the drawings. Where indicated on the drawings, limit percentage, by weight, of cementitious materials other than Portland cement in concrete.

C. Limit water-soluble, chloride-ion content in hardened concrete as listed on the drawings.

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

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Performance and Design Requirements:

1. Shrinkage: Shrinkage strain, determined in accordance with ASTM C 157 as amended and modified herein, shall not exceed the values below for each concrete class:
   a. Amendments and modifications to ASTM C 157:
      1) Storage: After initial 24 hour comparator reading, specimens are placed back in lime saturated water until age of seven days. At seven days another comparator reading is taken. This reading is used as the base reading which is used to calculate percent shrinkage. The specimens are stored at 50% humidity and 73° F.
      2) Test Reports: Report gage length (average of three) after 4, 7, 14, 28, and 56 days. In addition to the information required by ASTM C 157, Section 11, shrinkage test reports shall include gage lengths (initial length measurements) used to determine reported shrinkage strains.

   b. 28 Day Shrinkage Strain: Shrinkage strains shall not exceed the following:
      1) Concrete for slab-on-grade placed directly on vapor barrier: 0.046%.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion structural normal-weight concrete mixture as noted on Drawings, unless aggregates are “potentially reactive” with alkalis based on the ASTM C 295 or ASTM C 1260 or ASTM C 1293 testing limits of Section 5.1 of “Guide Specification of Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). When aggregates are “potentially reactive”, compliance with Section 5.2 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association) must be established through ASTM C 1567 testing for proposed alternate concrete mixture. Submit test reports in accordance with Part I of this Specification.

2.11 FABRICATING REINFORCEMENT

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

2.12 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.

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. Concrete adjacent to elevator hoistway shall be installed to tolerances required by elevator manufacturer.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.
3. The permissible irregularity is a cumulative value due to all sources including layout, plumbness, member size, formwork offsets, joints, and member levelness. The permissible irregularity shall also apply between adjacent concrete surfaces on opposite sides of construction joint, expansion joint or shrinkage pour strip if present.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

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

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

H. Chamfer exterior corners and edges of permanently exposed concrete.

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

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

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

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement. Form release agent shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
   a. Tolerance of Embedded Items: Comply with ACI 117.
      1) Anchor Rods:
         a) Plumbness: Within +/- 1/16 inch over anchor rod projection.

      2) Embedded Plates and Weldments:
         a) Location: +/- 1 inch vertical, +/- 1 inch horizontal.
         b) Plumb and Alignment: 1/4 inch in 12 inches (1:48).

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

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

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

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 in accordance ASTM E1643.

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

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Size, length, number and placement of supports shall be sufficient as to maintain reinforcing position within specified tolerances during construction traffic and concrete placement.

E. On vertical formwork, use approved bar chairs or spacers as required to maintain concrete cover and bar position. Do not staple or use any other metallic fastener to secure bolsters, chairs, etc. to formwork for concrete surfaces exposed to exterior.

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

G. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

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.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Space vertical joints in walls as indicated. Locate joints beside pilasters integral with walls, near corners, and in concealed locations where possible. Locate at centerline of support or middle third of span.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 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. All Other Interior Slabs-on-Grade: Unless noted otherwise on Drawings, locate construction joints on column centerlines. Locate control joints where shown on Drawings. If not shown, provide control joints at column centerlines and at intervals not more than 10 feet each way.

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 CONCRETE PLACEMENT

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

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. 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. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   a. Slabs supported by metal deck shall be gaged to provide the specified slab thickness over beams.

4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

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 or to be covered with a coating or covering material applied directly to concrete locations.

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, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

1. Apply scratch finish to surfaces indicated

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system

D. Top of surface for slabs
1. Slabs on ground shall be +/- .75”

E. Slab surface finish tolerance: Finish slab surfaces to the following tolerances according to 10-foot straight edge method, for a randomly trafficked floor surface:

1. At construction joints, finish and measure surface so gap at any point along the joint between concrete surface and an unleveled, freestanding, 10-foot-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4-inch Grind or fill-in surface of concrete to meet limits above at construction joints.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch

F. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

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

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

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

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

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

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. 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 with the following materials:
   a. Water.
   b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Moisture-retaining-cover shall be inspected each day by Contractor. Any areas which do not show condensation on underside of cover or any slab areas which are not wet shall be immediately rewetted and cover replaced to prevent moisture loss.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 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.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning and that are unacceptable to Architect. Allow Architect and Structural Engineer to observe concrete surfaces upon removal of forms and prior to repair of surface defects. Defects in structural concrete shall be brought to the attention of the Architect and Structural Engineer.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template. Submit proposed repair to Architect for review prior to commencement of work.

1. Repair finished surfaces containing defects that are unacceptable to Architect. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.031 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings and in Section 014010 – “Structural Testing and Inspection”.

END OF SECTION 033000

SECTION 042010 – REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 042000 "Unit Masonry" for additional masonry requirements.
2. Section 055000 "Metal Fabrications" for furnishing steel anchor rods, embedded plates, and bearing plates for unit masonry.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Unit Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide reinforced unit masonry that develops indicated net-area compressive strengths at 28 days, as indicated on drawings.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in TMS 602/ACI 530.1/ASCE 6.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Contractor will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with

specified requirements shall be done at Contractor's expense. Materials tested shall be the same in every way to the materials used to construct this project and shall be from the same lots or batches used for constructing this project.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: For the following:
   1. Reinforcing Steel: Detail bending and placement of reinforced unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls. Drawings shall include:

      a. 1/4-inch scale elevations of all beams, columns and walls with all openings and reinforcing shown.
      b. Top and bottom elevations of walls and bearing elevations of all elements supported.
      c. Size and location of all openings, pockets, embedments, and anchor bolts.
      d. Bar sizes, location and quantities of reinforcing steel.
      e. Location and arrangement of supporting and spacing devices.
      f. Bending and cutting schedules.
      g. All control joints, expansion joints and horizontal relief joints.
      h. All other framing and/or special conditions affecting the work.

1.7 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:

   1. Masonry units.

      a. Include material test reports substantiating compliance with requirements.
      b. Include data and calculations establishing average net-area compressive strength of units.

   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Grout: Submit grout strength test data. Data shall be in conformance with the requirements for concrete mix designs per Division 3 section “Cast-in-place concrete”
   a. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
   b. For self consolidating grout, include test reports for slump flow and visual stability index (VSI) as determined by ASTM C1611

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in TMS 602/ACI 530.1/ASCE 6.

1.8 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 latest edition unless modified by requirements in the Contract Documents.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as required to meet the specified prism strength, but in no case shall units be less than 2000 psi.
2. Density Classification: Lightweight unless otherwise indicated.

2.2 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure prefabricated lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.3 MORTAR AND GROUT MATERIALS

A. Blended Hydraulic Cement: ASTM C 595 Type IL, Portland-limestone cement.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable.

G. Additives: None permitted, except as specified herein. Specifically do not lower freezing point of mortar or grout by use of calcium chloride or other antifreeze agents.

2.4 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: As indicated on drawings
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.5 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed steel bolts complying with ASTM F1554 grade 36, or ASTM A307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.6 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. For reinforced masonry, use portland cement-lime mortar.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Reinforced Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Unless acceptable, do not hand mix mortar. Maintain workability of mortar by remixing or retempering. Discard mortar which has begun to stiffen or is not used within 2-½ hours after initial mixing.

D. Grout for Reinforced Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 7 in TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Grout shall attain a minimum compressive strength of 2000 psi at 28 days when tested in accordance with C1019.
3. Except for self-consolidating grout, mix and proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated.
4. Provide grout with a slump of 8 to 11 inches for grout heights less than 5 feet 4 inches, or 10 to 11 inches for grout lift heights greater than 5 feet 4 inches as measured according to ASTM C 143/C 143M, unless self-consolidating grout is used.
5. Self consolidating grout, if used, shall comply with the material requirements of ASTM C476; have a slump flow of 24 to 30 inches as determined by ASTM C1611/C1611M; and has a Visual Stability Index (VSI) less than or equal to 1 as determined in accordance with ASTM C1611/C1611M, Appendix X.1.
6. Proportioning of self-consolidating grout at the project site is not permitted. Do not add water at the project site except in accordance with the self-consolidating grout manufacturer's recommendations.
7. Do not use admixtures unless acceptable. Field additional of admixtures is not permitted in self-consolidating grout.

PART 3 - EXECUTION

3.1 LAYING MASONRY WALLS

A. Bond Pattern: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

B. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

C. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.2 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar each side of grouted cells.

3.3 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.4 CONTROL AND EXPANSION JOINTS

A. General: Install control joint materials in reinforced unit masonry as masonry progresses, as indicated on drawings.

3.5 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6, latest edition.

1. Support reinforcement to prevent displacement caused by construction loads or by placement of grout or mortar, beyond the allowable tolerances.
2. Completely embed reinforcing bars in grout.
3. Maintain clear distance between reinforcing bars and the interior of masonry unit or formed surface of at least 1/4 inch for fine grout and 1/2 inch for coarse grout, except where cross webs of hollow units are used as supports for horizontal reinforcement.
4. Place reinforcing bars maintaining the following minimum cover:
   a. Masonry face exposed to earth or weather: 2 inches for bars larger than No. 5; 11/2 inches for No. 5 bars or smaller.
   b. Masonry not exposed to earth or weather: 1 1/2 inches.

5. Maintain minimum clear distance between parallel bars of the nominal bar size or 1 inch, whichever is greater.
6. In columns and pilasters, maintain minimum clear distance between vertical bars of one and one-half times the nominal bar size or 1½ inches, whichever is greater.
7. Splice only where indicated on the Project Drawings, unless otherwise acceptable.
8. Unless accepted by the Architect/Engineer, do not bend reinforcement after it is embedded in grout or mortar.
9. Noncontact lap splices: Position bars spliced by noncontact lap splice no farther apart transversely than one-fifth the specified length of lap nor more than 8 inches
10. Joint reinforcement
    a. Place joint reinforcement so that longitudinal wires are embedded in mortar with a minimum cover of 1/2 inch when not exposed to weather or earth; or 5/8 inch when exposed to weather or earth.
    b. Provide minimum 6-inch lap splices for joint reinforcement.
    c. Ensure that all ends of longitudinal wires of joint reinforcement at laps are embedded in mortar or grout.

11. Placement Tolerances

    a. Place reinforcing bars in walls and flexural elements within a tolerance of 1/2 inch.
    b. Place vertical bars within:
       1) 2 inches of the required location along the length of the wall when the wall segment length exceeds 24 inches.
       2) 1 inch of the required location along the length of the wall when the wall segment length does not exceed 24 inches

    c. If it is necessary to move bars more than one bar diameter or a distance exceeding the tolerance stated above to avoid interference with other reinforcing steel, conduits, or embedded items, notify the Architect/Engineer for acceptance of the resulting arrangement of bars.
    d. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 inch horizontally for every 6 inches of vertical height.

C. Cleanouts: Provide cleanouts in the bottom course of masonry for each grout pour when the grout pour height exceeds 5 feet 4 inches.

1. Construct cleanouts so that the space to be grouted can be cleaned and inspected. In solid grouted masonry, space cleanouts horizontally a maximum of 32 inches on center.
2. Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimension shall be 3 inches.
3. After cleaning, close cleanouts with closures braced to resist grout pressure.

D. Grout Placement

1. Placing time: Place grout within 1-1/2 hours from introducing water in the mixture and prior to initial set.

   a. Discard site-mixed grout that does not meet the specified slump without adding water after initial mixing.
   b. For ready-mixed grout:
      1) Addition of water is permitted at the time of discharge to adjust slump.
      2) Discard ready-mixed grout that does not meet the specified slump without adding water, other than the water that was added at the time of discharge. The time limitation is waived as long as the ready-mixed grout meets the specified slump.

2. Confinement: Confine grout to the areas indicated on the Project Drawings. Use material to confine grout that permits bond between masonry units and mortar.
3. Grout pour height:

   a. Definition: The total height of masonry to be grouted prior to erection of additional masonry. A grout pour consists of one or more grout lifts.
   b. Do not exceed the maximum grout pour height given in TMS 602/ACI 530.1/ASCE 6, Table 7.

4. Grout lift height:

   a. Definition: An increment of grout height within a total grout pour. A grout pour consists of one or more grout lifts.
   b. For grout except self-consolidating grout:
      1) Where the following conditions are met, place grout in lifts not exceeding 12 feet 8 inches.
         a) The masonry has been cured for at least four hours.
         b) The grout slump is maintained between 10 and 11 inches.
         c) No intermediate reinforced bond beams are placed between the top and the bottom of the pour height.

      2) When there are intermediate bond beams within the grout pour, limit the grout lift height to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed a grout lift height of 12 feet 8 inches.
      3) When the conditions above are not met, place grout in lifts not exceeding 5 feet 4 inches.

5. For self-consolidating grout:

    a. When placed in masonry that has cured for at least 4 hours, place in lifts not exceeding the grout pour height.
    b. When placed in masonry that has not cured for at least 4 hours, place in lifts not exceeding 5 feet 4 inches.

E. Consolidation

1. Consolidate grout at the time of placement.

    a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.
    b. Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
    c. Consolidation or reconsolidation is not required for self-consolidating grout.

F. Grout key: When grouting, form grout keys between grout pours. Form grout keys between grout lifts when the first lift is permitted to set prior to placement of the subsequent lift.

1. Form a grout key by terminating the grout a minimum of 1 1/2 inches below a mortar joint.
2. Do not form grout keys within beams.
3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.

3.6 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings and in Section 014010 – “Structural Testing and Inspection”.

END OF SECTION 042010

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Sections:

1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 2 inches.
2. Welded built-up members with plates thicker than 2 inches.

D. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Connections:

1. Provide connections as shown or noted on Drawings. Design of connections not shown or noted shall be provided by Structural Engineer-of-Record upon request.
2. Alternate connections designed by the contractors registered design professional may be substituted by the Contractor, subject to Structural Engineer-of-Record approval. Proposed changes to connections shall be submitted as a substitution request in advance of the submittal of shop drawings for conceptual approval of Structural Engineer-of-Record. Connections shall be designed for loads indicated on drawings or provided by Structural Engineer-of-Record. Loads indicated are developed using Load and Resistance Factor Design (LRFD) load combinations unless noted otherwise. One set of calculations for all alternate connections signed and sealed by a qualified engineer shall be submitted with or in advance of applicable shop drawings. Contractor shall submit alternate connections to the AHJ in accordance with IBC section A107.3.4.1 Deferred Submittal and A107.4 Amended Construction Documents.

B. Construction: Refer to the Drawings for description of lateral load resisting system.

1.5 ACTION SUBMITTALS

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

B. Shop and Erection Drawings: Show location, fabrication, and assembly of structural-steel components.

1. Location of each piece or detail within the structure.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment piece and setting drawings.
4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
6. Identify members and connections of the seismic-load-resisting system.
7. Identify demand critical welds.
8. Drawings submitted in multiple packages shall contain individual submittals complete with all applicable erection drawings, details, and piece drawings.
9. Reproduction of Contract Documents is not permitted.
10. Provide schedule for submittal of shop and erection drawings.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties and steel mill of origin.

1. For structural steel products that are manufactured in a different facility than where the raw material is produced, the mill test report or separate letter included with the report shall clearly indicated the location of both facilities.
2. If structural steel elements are sourced from multiple facilities, mill test reports shall be provided for each facility with a statement outlining the applicability of each report submitted.

E. Product Test Reports: For the following if present on project:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shop primers.
5. Non shrink grout.

F. Environmental Product Declaration (EPD) Disclosure: For each type of structural steel element used on the project provide a current, product specific, third party verified, type III EPD conforming to ISO 14025 and the North American product category rule (PCR) for Steel Construction Products.
1. If structural steel elements are sourced from multiple facilities, EPD data shall be provided for each facility with a statement outlining the applicability of each EPD submitted.
2. Submitted EPDs shall demonstrate conformance to the global warming potential limits indicated in the construction documents.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC 420 “Certification Standard for Shop Application of Complex Protective Systems” Paint Endorsement CCE1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Field Painting Applicators: Qualified according to SSPC-QP1, “Standard Procedure for Evaluating Qualifications of Painting Contractors “Field Application to Complex Structures”.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

F. Comply with applicable provisions of the following specifications and documents:

1. AISC 303 -2016 as amended below:
   a. Section 3.2: Replace entire section with the following: “Requirements for structural steel including quantities, sizes, locations, arrangement, and details shall be shown or noted in the overall Contract Drawing package. Fabricator is responsible for incorporating all such information from structural, architectural, mechanical, and electrical drawings, as well as those of other disciplines.”
   b. Section 3.5: Remove all text after first sentence.
   c. Section 3.6: Replace entire section with the following: “When the fast-track project delivery system is selected, release of structural drawings shall constitute release for construction only if specifically noted as such on the drawing. Drawing indicated “preliminary” or “not for construction” shall not be used for detailing or construction except where the risk of any cost or delay associated with subsequent revisions to Contract Documents is accepted by the Owner, Contractor or Fabricator.”
   d. Section 4.4: Revise second sentence to read the following: “The shop and erection drawings shall be returned in accordance with the schedule defined in Division 1 of the project Specification. In the absence of such schedule, the Owner’s Designated Representative for Design shall return submittals within 14 calendar days of receipt from the Owner’s Designated Representative for Construction.”
2. AISC 341 and AISC 341s.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

G. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.9 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

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

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Supply structural steel materials produced and manufactured in the United States of America or Canada for all elements listed in this section and as required in the construction documents.

B. W-Shapes: As indicated on Drawings.

C. Channels, Angles-Shapes: As indicated on Drawings.

D. Plate and Bar: As indicated on Drawings.

E. Cold-Formed Hollow Structural Sections: As indicated on Drawings.

F. Steel Pipe: As indicated on Drawings.

1. Weight Class: as indicated on Drawings.
2. Finish: Black except where indicated to be galvanized.

G. Welding Electrodes: Comply with AWS requirements, 70 Series

1. Conform to Charpy V-Notch test requirements of AISC 360.
2. Conform to Charpy V-Notch test requirements of AISC 341 for components included in the Seismic-Load-Resisting System.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Use Tension-Control, High-Strength Bolt-Nut-Washer Assemblies whenever possible unless indicated otherwise.

B. High-Strength Bolts, Nuts, and Washers: ASTM F 3125, Group 120, Type 1 A325 or F1852. Heavy-hex steel structural bolts; ASTM A 563, Type 1 Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; or Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers all with plain finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

D. Steel Headed Stud Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 55, weldable.

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain

F. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

G. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

H. Deformed Anchor Studs (DAS) / Deformed Bar Anchors (DBA): Made from ASTM A 108 low carbon steel, cold worked and deformed per ASTM A 1064. Minimum yield stress = 60ksi; minimum tensile strength = 80ksi.

I. Rebar: Rebar used for welding shall meet the requirements of ASTM A-706. Minimum bend diameters per ACI 318.

J. Expansion Anchors, Screw Anchors, and Adhesive Anchors: Size and Manufacturer as indicated on Drawings. Complete assemblies with required rods, nuts, washers, and adhesive system as applicable. Installed in accordance with Manufacturer's installation instructions. Current ICC approval and published ICC Research Report required.

1. Finish for use in conditioned environments free from potential moisture (interior): Plain or in accordance with Manufacturer's standard.
2. Finish for use in exposed or potentially wet environments and for attachment of exterior cladding materials: Galvanized in conformance with ASTM A 153 or stainless steel, Series 316.
3. Finish for use in exposed to ocean or waterfront type 316 stainless steel.

2.3 PRIMER

A. Low-Emitting Materials: Paints and coatings 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."

B. Primer: Where steel is to be field painted, provide fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time. Minimum compressive strength = 6000 psi.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. Minimum compressive strength = 6000 psi. Required where grout is exposed to view or weathering.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations, if applicable.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not enlarge bolt holes by burning.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning or SSPC-SP 3, "Power Tool Cleaning."

F. Steel Headed Stud Anchors and Deformed Anchor Studs / Deformed Bar Anchors: Prepare steel surfaces as recommended by manufacturer of anchors. Use automatic end welding of anchors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, thermal cut, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

H. Splices: Splicing of members to obtain required lengths is not permitted without prior approval of structural Engineer-of-Record unless indicated on the Drawings.

I. Substitutions: Where exact sizes and weights indicated on Drawings are not readily available, secure approval of alternate sizes from Structural Engineer-of Record in time to prevent project delay.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: As indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches
2. Surfaces to be field welded, including top flange of beams to receive steel headed stud anchors.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

6. Surfaces not otherwise indicated to be painted that are not exposed to view or weather in the final condition.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to either of the following specifications and standards:

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes in closed sections (HSS or Pipe) that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

2.9 SOURCE QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Coordinate installation of non-structural steel items that load the temporarily supported steel frame such that temporary supports are adequate to resist all imposed loads.

2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3. Do not apply permanent loading other than the weight to supported concrete slab-on-deck assemblies to composite beams and girders until concrete has achieve 75 percent of its design strength without prior approval of structural Engineer-of-Record.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of the plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate where indicated on Drawings.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Clean and moisten surfaces to receive grout. Immediately remove any remaining free water. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature of 70° F when structure is completed and in service.

E. Splice members only where indicated.

1. Fasten splices in compression after bearing surface have been brought into contact. Close all gaps greater than 1/16-inch by driving non-tapered mild steel shims full depth of bearing surface along full length of gap.

F. Do not use thermal cutting during erection unless approved by Structural Engineer-of-Record. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

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

H. Steel Headed Stud Anchors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

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

1. Joint Type: As indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated on Drawings, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings and in Section 014010 – “Structural Testing and Inspection”.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
3. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
4. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Provide products with an average recycled content of steel products not less than as indicated on the structural drawings.

D. Low-Emitting Materials: Paints and coatings 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."

2.2 ROOF DECK

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

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.

8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Deck," and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), grade, thickness and profile as indicated on the structural drawings, G90 zinc coating. Use at locations not indicated to be painted.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), grade, thickness and profile as indicated on the structural drawings, , G90 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer. Use at locations indicated to be painted.
   a. Color: Manufacturer's standard.

3. Span Condition: As indicated on the structural drawings.
4. Side Laps: Overlapped.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated but not less than recommended by SDI for overhang and slab depth.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

H. Galvanizing Repair Paint: ASTM A 780.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations. Obtain prior written approval from Structural Engineer-of-Record before installing shoring.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

1. Refer to Drawings for opening sizes requiring reinforcement and typical reinforcement options.
2. Miscellaneous openings not shown on the Drawings such as those required for vents, risers, conduits, etc. shall be cut and reinforced if necessary, by the trade requiring the opening.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck with prior written approval of Structural Engineer-of-Record. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels as indicated on the structural drawings. Provide weld washer at each location where uncoated deck of thickness 0.028 inches or less is being fastened to supporting members by welding.

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing length as indicated on the structural drawings, with end joints as follows:

1. End Joints: Lapped as indicated on the structural drawings.

C. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings and in Section 014010 – “Structural Testing and Inspection”.

3.5 PROTECTION

A. Galvanizing Repairs: Where deck is exposed to weather or moisture, prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

1. Do not use deck units for storage or as a working platform until permanently secured in position.
2. Contractor shall assure that completed deck is not damaged by use as a runaway, storage of materials or subsequent work.
3. Contractor shall assure that construction loads are not allowed which exceed the safe carrying capacity of the deck.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior load-bearing wall framing.
2. Interior load-bearing wall framing.
3. Exterior non-load bearing and soffit wall framing.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
2. Division 09 Section "Non-Structural Metal Framing" for interior non-load bearing, metal-stud framing and ceiling-suspension assemblies.
3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load bearing, metal-stud-framed, shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on drawings.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than those indicated on the drawings.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate deflection of primary building structure as indicated on the drawings.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Provide 1/4-inch = 1-feet-0-inches scale elevations of all walls and plans of all soffits comprised of cold-formed metal framing. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Vertical deflection clips.
2. Horizontal drift deflection clips.
3. Stiff Clips.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Special Inspections and Testing: Special inspections and tests indicated on the construction documents and indicated within this specification are minimum requirements. The cold-formed metal framing construction documents shall include the minimum testing and inspection requirements as indicated on the construction documents and shall include additional testing and inspections that the engineer of the cold-formed metal framing engineer requires. All special inspections and tests (minimum design requirements on construction documents and those specified by cold-formed metal framing engineer) shall be paid for by the Owner.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code-Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Allied Studco.
2. AllSteel Products, Inc.
3. California Expanded Metal Products Company.

4. Clark Steel Framing.
5. Consolidated Fabricators Corp.; Building Products Division.
6. Craco Metals Manufacturing, LLC.
7. Custom Stud, Inc.
8. Dale/Incor.
9. Design Shapes in Steel.
10. Dietrich Metal Framing; a Worthington Industries Company.
11. Formetal Co. Inc. (The).
12. Innovative Steel Systems.
13. MarinoWare; a division of Ware Industries.
14. Quail Run Building Materials, Inc.
15. SCAFCO Corporation.
16. Southeastern Stud & Components, Inc.
17. Steel Construction Systems.
18. Steeler, Inc.
19. Super Stud Building Products, Inc.
20. United Metal Products, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H, 33ksi for studs 18 gauge and lighter.
2. Coating: G60, or equivalent

B. Steel Sheet for Vertical Deflection, Stiff Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1 or 2.
2. Coating: G90.
3. Gauge: 14 gauge minimum.

2.3 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inches as indicated.
2. Minimum Flange Width: 1-5/8 inches and as indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Minimum Flange Width: 1-1/4 inches and as indicated

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch and as required.
2. Flange Width: 1-5/8 inches and as required.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch and as indicated.
2. Minimum Flange Width: 1-5/8 inches and as indicated.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Minimum Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web. Maximum deflection of the clip/stud assembly under design load shall be the smaller of 1/8-inch or the elastic limit load.

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

a. Dietrich Metal Framing; a Worthington Industries Company.
b. MarinoWare, a division of Ware Industries.
c. SCAFCO Corporation
d. The Steel Network, Inc.

D. Maximum track lateral deflection under design load shall not exceed 1/8-inch or the elastic limit load.

E. Stiff Clips: Clip capable of supporting design loads indicated through positive mechanical attachment to the stud web. Maximum deflection of the clip/stud assembly under design loads shall be the smaller of 1/8-inch or the elastic limit load.

2.5 EXTERIOR SOFFIT FRAMING

A. Steel Soffits: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with enlarged service holes with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inches.
2. Flange Width: 1-5/8 inches minimum.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 55, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of the wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: as shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Maximum Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Connect vertical deflection clips to bypassing and infill studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.6 FIELD QUALITY CONTROL

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

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

F. Perform inspections as indicated on Drawings and in Section 014010 – “Structural Testing and Inspection”.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.

B. Downspout boots.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

2.02 MATERIALS - ALUMINUM

END OF SECTION

SECTION 057000
DECORATIVE METAL

PART 1 GENERAL

1.01 Section Includes

A. Decorative metal units.

PART 2 PRODUCTS

2.01 DECORATIVE METAL UNITs

PART 3 EXECUTION

3.01 Examination

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

3.02 Preparation

A. Protect existing work.

B. Clean surfaces to receive units. Remove materials and substances detrimental to installation.

3.03 Installation

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Concealed wood blocking, nailers, and supports.

C. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS

A. PS 20 - American Softwood Lumber Standard; 2025.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

END OF SECTION

SECTION 061053
MISCELLANEOUS ROUGH CARPENTRY

PART 2 PRODUCTS

1.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

END OF SECTION

SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

D. Factory finishing.

E. Preparation for installing utilities.

1.02 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 Panel Core Materials

2.04 Hardwood Plywood Panels

2.05 Thermally Fused Laminate Panels

2.06 Lacquered Panels

2.07 COUNTERTOPS

2.08 ACCESSORIES

2.09 HARDWARE

2.10 FABRICATION

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

3.03 ADJUSTING

A. Adjust installed work.

B. Adjust moving or operating parts to function smoothly and correctly.

END OF SECTION

SECTION 071400
FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 REFERENCE STANDARDS

A. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

PART 2 PRODUCTS

2.01 FLUID-APPLIED WATERPROOFING MATERIALS

PART 3 EXECUTION

3.01 EXAMINATION

3.02 PREPARATION

3.03 INSTALLATION

A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.

B. Seal membrane and flashings to adjoining surfaces.

END OF SECTION

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

B. Section 072600 - Vapor Retarders: Separate vapor retarder materials.

C. Section 072700 - Air Barriers: Separate air barrier materials.

D. Section 075100 - Built-Up Bituminous Roofing: Installation requirements for board insulation over low slope roof deck.

E. Section 075200 - Modified Bituminous Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

F. Section 075300 - Elastomeric Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

G. Section 075400 - Thermoplastic Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 PRODUCTS

2.01 APPLICATIONS

PART 3 EXECUTION

3.01 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.02 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 072400
EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating over cementitious base coat, Class PM.

B. Drainage and water-resistive barriers behind insulation board.

1.02 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

B. ASTM C297/C297M - Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions; 2016.

C. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2013 (Reapproved 2019).

D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2022.

E. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2015 (Reapproved 2020).

F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

G. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

H. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.

I. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).

J. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

K. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).

L. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).

M. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.

N. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.

O. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

PART 2 PRODUCTS

2.01 EXTERIOR INSULATION AND FINISH SYSTEM

A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on flat-backed insulation board adhesive-applied directly to water-resistive coating over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.

B. Fire Characteristics:
1. Flammability: Pass, when tested in accordance with NFPA 285.
2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot (mJ/sq m).

C. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum flatwise tensile bond strength of 15 psi (105 kPa), when tested in accordance with ASTM C297/C297M.

D. Adhesion to Water-Resistive Coating: For each combination of insulation board and substrate, when tested in accordance with ASTM C297/C297M, maximum adhesive failure of 25 percent unless flatwise tensile bond strength exceeds 15 psi (105 kPa) in all samples.

E. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf (299 Pa) differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.

F. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.

G. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches (100 by 150 mm) in size.

H. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.

I. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.

J. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.

K. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.

L. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.

2.02 MATERIALS

A. Water-Resistive Barrier Coating: Fluid-applied air and water barrier membrane; applied to sheathing; furnished or approved by EIFS manufacturer.

2.03 ACCESSORIES

A. Insulation Adhesive: Type required by EIFS manufacturer for project substrate.

B. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.

C. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.

B. Verify that substrate surface is flat, with no deviation greater than 1/4 in (6 mm) when tested with a 10 ft (3 m) straightedge.

3.02 PREPARATION

3.03 INSTALLATION - GENERAL

A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
   1. Where different requirements appear in either document, comply with the most stringent.
   2. Neither of these documents supercedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.04 INSTALLATION - WATER-RESISTIVE BARRIER

A. Apply barrier coating as recommended by coating manufacturer; prime substrate as required before application.

B. Seal substrate transitions and intersections with other materials to form continuous water-resistive barrier on exterior of sheathing, using method recommended by manufacturer.

C. At door and window rough openings and other wall penetrations, seal water-resistive barrier and flexible flashings to rough opening before installation of metal flashings, sills, or frames, using method recommended by manufacturer.

D. Lap flexible flashing or flashing tape at least 2 inches (50 mm) on each side of joint or transition.

3.05 INSTALLATION - INSULATION

A. Install in accordance with manufacturer's instructions.

B. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.

C. On wall surfaces, install boards horizontally. On horizontal surfaces, install boards _____ .

D. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch (1.6 mm).

E. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.

F. Rasp irregularities off surface of installed insulation board.

END OF SECTION

SECTION 072726
FLUID-APPLIED MEMBRANE AIR BARRIERS - DOW

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fluid-applied membrane air barriers.

1.02 DEFINITIONS

A. Air Barrier: Airtight barrier made of material that is relatively air impermeable but water vapor permeable, both to degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1.03 REFERENCE STANDARDS

A. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

B. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluid-Applied Membrane Air Barrier:

2.02 FLUID-APPLIED MEMBRANE AIR BARRIER ASSEMBLY

A. Applications:

B. Fluid-Applied Membrane Air Barrier: Single-component, vapor permeable, 100 percent silicone elastomeric air barrier.
   1. Vapor Permeance: 10 perms (574 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M using Desiccant Method at 73.4 degrees F (23 degrees C).
   2. Air Barrier Leakage: Not greater than 0.04 cfm/sq ft (0.2 L/sq m) of surface area at pressure of 1.57 psf (75 Pa) when tested in accordance with ASTM E2357.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept work of this section.

B. Verify that surfaces are clean, dry, and free of frost, dust, dirt, grease, oil, curing compounds, form release agents, laitance, efflorescence, mildew, excess alkalinity, and other conditions affecting performance of this work.

3.02 PREPARATION

A. Protect work of other trades against damage from application of air barrier coatings.

B. Protect adjacent surfaces not designated to receive air barrier coatings; provide protection for pedestrians, vehicles, landscaping, and surrounding areas to prevent contact with coating materials.

C. Clean substrates to remove contaminants and foreign material by pressure cleaning, wire brushing, grinding or other method recommended by air barrier coatings manufacturer.

D. Prepare substrates in accordance with air barrier coating manufacturer's written instructions.

E. Repair deteriorated or damaged substrates, repair masonry joints, and fill cracks, voids, honeycombs, and other defects using materials as recommended by air barrier coating manufacturer, and allow patching materials to fully cure.
   1. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
   2. Fill cracks larger than 1/16 inch (1.6 mm) wide using applicable joint sealant, and fill cracks larger than 1 inch (25.4 mm) wide using joint sealant and compatible bond breaker where movement is expected.

3.03 APPLICATION

A. Apply air barrier system materials in accordance with manufacturer's instructions.

B. Transition Strips and Silicone Sealants: Install with approved sealants in accordance with manufacturer’s written instructions.
   1. Form sealed joints to windows, wall framing systems, door and louver frames, roofing system perimeters, and at interface with other adjacent materials utilizing compatible components that form air barrier assembly.

C. Air Barrier Coating: Apply air barrier coating using application methods and rate of application recommended by manufacturer, using nap roller or airless sprayer, in accordance with requirements of authorities having jurisdiction (AHJ).
   1. Provide wet application not less than 30 mils, 0.030 inch (0.76 mm) thick, or more as required by substrate conditions, with dry film thickness (DFT) not less than 15 mils, 0.015 inch (0.38 mm) thick.

END OF SECTION

SECTION 074113
METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulated metal roof panel system of preformed aluminum panels.

1.02 REFERENCE STANDARDS

A. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
   1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
   2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
   3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

2.02 ATTACHMENT SYSTEM

2.03 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

B. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

C. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.

1. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

END OF SECTION

SECTION 075419
POLYVINYL-CHLORIDE ROOFING - DURO-LAST

PART 2 PRODUCTS

1.01 Manufacturers

A. Duro-Last Roofing, Inc: www.duro-last.com/#sle.

1.02 Membrane Roofing Systems

1.03 Performance Requirements

A. Factory Mutual Classification: Class 1, windstorm resistance of 1-60 in accordance with FM DS 1-28, and attach roof deck and above-deck components in accordance with FM DS 1-29.

B. Wind Uplift Resistance:
   1. Designed to withstand wind uplift forces calculated in accordance with ASCE 7.

C. Roof Covering External Fire Resistance Classification: Comply with UL (DIR), Class A.

D. Provide roof coverings in accordance with ASTM E108 and ASTM E119.

1.04 Membrane

A. Thermoplastic Polyvinyl-Chloride (PVC) Roofing Membrane: Single-ply membrane over insulation with vapor barrier and cover board as indicated on drawings; in accordance with ASTM D4434/D4434M.

B. PVC: Comply with ASTM D4434/D4434M, Type III, internally reinforced sheet with fabric backing.

C. Solar Reflectance for EnergySmart Membranes and Color: Minimum 0.85 - white for initial and 0.67 - white for three years in accordance with ASTM C1549.

D. Thermal Emittance for EnergySmart Membranes and Color: Minimum 0.89 - white in accordance with ASTM C1371.

E. Thickness: 40 mils, 0.040 inch (1.02 mm), minimum, in accordance with ASTM D751.

F. Sheet Width: 32 inches (812 mm).

G. Color: White.

END OF SECTION

SECTION 077100
ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and gravel stops.

B. Roof control and expansion joint covers.

1.02 REFERENCE STANDARDS

A. NRCA (RM) - The NRCA Roofing Manual; 2025.

PART 2 PRODUCTS

2.01 COMPONENTS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

END OF SECTION

SECTION 077200
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Eave vents.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 REFERENCE STANDARDS

A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

PART 2 PRODUCTS

2.01 JOINT SEALANTS - GENERAL

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

SECTION 079513
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies for floor, wall, ceiling, soffit, and _____ surfaces.

PART 2 PRODUCTS

2.01 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   4. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hollow metal frames for wood doors.

1.02 RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

2.03 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Install door hardware as specified in Section 087100.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

END OF SECTION

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, special function, and _____.

PART 2 PRODUCTS

2.01 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.

2.02 DOOR AND PANEL CORES

2.03 DOOR FACINGS

2.04 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

C. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

D. Provide edge clearances in accordance with the quality standard specified.

2.05 FINISHES - WOOD VENEER DOORS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

SECTION 084313
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Infill panels of metal and glass.

C. Aluminum doors and frames.

D. Weatherstripping.

E. Door hardware.

1.02 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

C. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS

2.01 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Glazing Position: Centered (front to back).
   2. Finish: Superior performing organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.02 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, hollow metal, and _____ doors.

B. Electrically operated and controlled hardware.

C. Lock cylinders for doors that hardware is specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section 062000 - Finish Carpentry: Wood door frames.

B. Section 081113 - Hollow Metal Doors and Frames.

C. Section 081116 - Aluminum Doors and Frames.

D. Section 081416 - Flush Wood Doors.

E. Section 081423 - Clad Wood Doors.

F. Section 081433 - Stile and Rail Wood Doors.

G. Section 084313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.

H. Section 084413 - Glazed Aluminum Curtain Walls: Door hardware, except cylinders.

I. Section _____: Power supply to electric hardware devices.

1.03 REFERENCE STANDARDS

A. BHMA A156.1 - Standard for Butts and Hinges; 2021.

B. BHMA A156.3 - Exit Devices; 2025.

C. BHMA A156.4 - Door Closers and Pivots; 2024.

D. BHMA A156.14 - Sliding and Folding Door Hardware; 2024.

E. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.

F. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.

2.02 HINGES

A. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Provide hinges on every swinging door.
   2. Provide following quantity of butt hinges for each door:

2.03 PIVOTS

2.04 FLOOR CLOSERS

A. Floor Closers: Comply with BHMA A156.4, Grade 1.

2.05 TRACK AND HANGERS

A. Sliding and Bifolding Door Hardware: Comply with BHMA A156.14.
   1. Provide track, hanger fasteners, guides, and pulls; size track and hangers in accordance with manufacturer's recommendations for weight of doors.
   2. Provide one pull for each pair of panels hinged together.

2.06 EXIT DEVICES

A. Exit Devices: Comply with BHMA A156.3, Grade 1.
   1. Lever design to match lockset trim.
   2. Provide cylinder with cylinder dogging or locking trim.
   3. Provide exit devices properly sized for door width and height.
   4. Provide strike as recommended by manufacturer for application indicated.
   5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.07 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
   1. Provide cylinders from same manufacturer as locking device.

2. Provide cams and/or tailpieces as required for locking devices.

2.08 WALL STOPS

A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
1. Type: Bumper, concave, wall stop.
2. Material: Aluminum housing with rubber insert.

2.09 FINISHES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Use templates provided by hardware item manufacturer.

C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

D. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 ADJUSTING

A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 PROTECTION

A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 088000
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

1.02 REFERENCE STANDARDS

A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

B. GANA (SM) - GANA Sealant Manual; 2008.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 GLASS MATERIALS

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

END OF SECTION

SECTION 090561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.

B. Removal of existing floor coverings.

C. Preparation of new and existing concrete floor slabs for installation of floor coverings.

1.02 REFERENCE STANDARDS

A. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.03 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

C. Adhesive Bond and Compatibility Test Report.

D. Copy of RFCI (RWP).

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Specified remediation, if required.
   3. Patching, smoothing, and leveling, as required.
   4. Other preparation specified.
   5. Adhesive bond and compatibility test.
   6. Protection.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.

B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.04 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.05 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 090561
SUBSTRATE PREPARATION FOR FLOORING INSTALLATION- USG

PART 1 GENERAL

1.01 Section Includes

A. Removal of existing floor coverings.

B. Preparation of new and existing concrete floor slabs for installation of floor coverings.

1.02 Submittals

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Visual Observation Report: For existing floor coverings to be removed.

C. Adhesive Bond and Compatibility Test Report: For each type of adhesive or setting material.

PART 2 PRODUCTS

2.01 Materials

PART 3 EXECUTION

3.01 Sequence of Procedures

A. Patching, smoothing, and leveling of substrates, as required.

B. Other preparation specified.

C. Adhesive bond and compatibility test performed by affected flooring installer.

D. Protection.

3.02 Protection

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 092216
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal partition, ceiling, and soffit framing.

B. Framing accessories.

1.02 REFERENCE STANDARDS

A. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

1.04 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:
1. ClarkDietrich; _____: www.clarkdietrich.com/#sle.
2. Simpson Strong Tie; ____: www.strongtie.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

2.02 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
1. Studs: C-shaped with flat faces.
2. Runners: U-shaped, sized to match studs.
3. Ceiling Channels: C-shaped.
4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 INSTALLATION OF STUD FRAMING

A. Extend partition framing to structure where indicated and to ceiling in other locations.

B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

C. Align and secure top and bottom runners at 24 inches (600 mm) on center.

D. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

E. Align stud web openings horizontally.

F. Secure studs to tracks using crimping method. Do not weld.

G. Fabricate corners using a minimum of three studs.

H. Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.

I. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

J. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches (150 mm).

END OF SECTION

SECTION 092236
LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lath for cement and gypsum plaster.

1.02 REFERENCE STANDARDS

A. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.

B. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.

PART 2 PRODUCTS

2.01 LATH

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrates are ready to receive work and conditions are suitable for application.

C. Do not begin until unacceptable conditions have been corrected.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.

3.03 CONTROL AND EXPANSION JOINT INSTALLATION

A. Locate joints as indicated on drawings and comply with ASTM C1063.

3.04 LATH INSTALLATION

A. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches (75 mm) from corner to form the angle reinforcement; fasten at perimeter edges only.

B. Place corner bead at external wall corners; fasten at outer edges of lath only.

C. Place base screeds at termination of plaster areas; secure rigidly in place.

D. Place lath vertically above each top corner and each side of door frames to 6 inches (150 mm) above ceiling line.

E. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

F. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

END OF SECTION

SECTION 092300
GYPSUM PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum plastering.

1.02 REFERENCE STANDARDS

A. ASTM C842 - Standard Specification for Application of Interior Gypsum Plaster; 2005 (Reapproved 2021).

PART 2 PRODUCTS

2.01 PLASTER MIXES

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing conditions are satisfactory before starting work.

B. Grounds and Blocking: Verify items within walls for other sections of work have been installed.

3.02 PREPARATION

3.03 PLASTERING

A. Apply gypsum plaster in accordance with ASTM C842 and manufacturer's instructions.

B. Thickness of Plaster including Finish Coat:

END OF SECTION

SECTION 092400
CEMENT PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cement plastering.

1.02 REFERENCE STANDARDS

A. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2023a.

PART 2 PRODUCTS

2.01 CEMENT PLASTER APPLICATIONS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

3.02 PREPARATION

3.03 Mixing

A. Mix only as much plaster as can be used prior to initial set.

B. Mix materials dry, to uniform color and consistency, before adding water.

C. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.04 APPLICATION

A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.

3.05 REPAIR

A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

END OF SECTION

SECTION 093000
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Cementitious backer board as tile substrate.

1.02 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.

B. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

C. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

PART 2 PRODUCTS

2.01 TILE

2.02 SETTING MATERIALS

2.03 GROUTS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive tile.

B. Verify wall surfaces are smooth and flat within tolerances specified for that type of work, are dust-free, and are ready to receive tile.

3.02 Preparation

A. Vacuum clean surfaces and damp clean.

B. Seal substrate surface cracks with filler.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108/A118/A136, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.

B. Lay tile to pattern indicated on drawings. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Sound tile after setting. Replace hollow sounding units.

G. Keep control and expansion joints free of mortar, grout, and adhesive.

H. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

I. Grout tile joints unless otherwise indicated on drawings. Use standard grout unless otherwise indicated on drawings.

J. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

2.02 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

B. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

C. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

D. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

E. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

F. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

END OF SECTION

SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

1.02 REFERENCE STANDARDS

A. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Composition Tile - Type ____: Homogeneous, with color extending throughout thickness.
   1. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
   2. Size: 12 by 12 inch (305 by 305 mm).
   3. Thickness: 0.125 inch (3.2 mm).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.02 PREPARATION

3.03 Installation - General

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

3.04 Installation - Tile Flooring

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096519
RESILIENT TILE FLOORING - KARNDEAN

PART 1 GENERAL

1.01 Section Includes

A. Resilient tile flooring.

B. Installation accessories.

1.02 Reference Standards

A. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

PART 2 PRODUCTS

2.01 Resilient Tile Flooring

2.02 Installation Accessories

A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 Examination

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.02 Preparation

A. Remove existing resilient flooring and adhesives; follow RFCI (RWP) recommendations.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.03 Installation - General

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

3.04 Installation - Tile

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 Protection

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 096566
RESILIENT ATHLETIC FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vinyl sheet flooring, adhesively installed.

1.02 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.03 FIELD CONDITIONS

A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F (21 to 35 degrees C) for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F (10 degrees C) or to go above 100 degrees F (38 degrees C).

PART 2 PRODUCTS

2.01 PREFORMED ATHLETIC FLOORING

A. Vinyl Sheet Flooring:
1. Wearing Surface: Pure polyvinyl chloride, mechanically extruded and uniformly resilient material with uniform color throughout thickness.
2. Backing: None.
3. Sheet Thickness: Minimum 9/32 inch (7 mm), nominal.
4. Sheet Width: Minimum 48 inches (1220 mm).
5. Sheet Lengths: As necessary to minimize transverse seams.
6. Tensile Strength: Minimum 1000 psi (6.9 MPa), per ASTM D412.
7. Durometer Hardness, Type A: Minimum of 65, when tested in accordance with ASTM D2240.
8. Seaming Method: Welding with heat or chemical.
9. Surface Texture: Smooth.
10. Color: As selected from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.

3.02 PREPARATION

A. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.

B. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Resilient Sheet Flooring:
1. Unroll flooring and allow to relax before beginning installation.
2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.
3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
5. Weld seams using techniques and equipment recommended by manufacturer.
6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

3.04 CLEANING

A. Clean flooring using methods recommended by manufacturer.

3.05 PROTECTION

A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION

SECTION 096813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

B. Removal of existing carpet tile.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tile Carpeting, Type _____: Tufted, manufactured in one color dye lot.

PART 3 EXECUTION

3.01 EXAMINATION

A. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Remove existing carpet tile.

B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 099113
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:
1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concrete masonry units in utility, mechanical, electrical, and _____ spaces.
8. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:
1. Behr Paint Company: www.behr.com/#sle.
2. Dunn-Edwards Corporation: www.dunnedwards.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

B. Primer Sealers: Same manufacturer as top coats.

C. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Fiber Cement Siding: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:

G. Masonry:

H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 099123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.
2. Where sheen is not specified, submit each color in each sheen available.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:
1. Behr Paint Company: www.behr.com/#sle.
2. Dunn-Edwards Corporation; _____: www.dunnedwards.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower and bath accessories.

C. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 088300 - Mirrors: Other mirrors.

B. Section 093000 - Tiling: Ceramic washroom accessories.

C. Section 224000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).

D. ASTM C1036 - Standard Specification for Flat Glass; 2021.

E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc; _____: www.americanspecialties.com/#sle.

2. Bradley Corporation; _____: www.bradleycorp.com/#sle.
3. Georgia-Pacific Professional; _____: www.gppro.com/#sle.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Stainless Steel Sheet: ASTM A666, Type 304.

C. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.04 Commercial Toilet Accessories

A. Toilet Paper Dispenser: Double roll, surface mounted, for cored or coreless type rolls.

B. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.

C. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
c. Finish: Satin.
d. Length and Configuration: As indicated on drawings.

D. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 Commercial Shower and Bath Accessories

A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.

B. Shower Curtain:
   1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.

C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.

D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.

E. Towel Bar: Stainless steel, 3/4 inch (20 mm) square tubular bar; rectangular brackets, concealed attachment, satin finish.

F. Towel Pin: Stainless steel, 3 inch (75 mm) extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.

G. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 Utility Room Accessories

A. Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, hat-shaped channel.
   1. Holders: Three spring-loaded rubber cam holders.
   2. Length: 36 inches (900 mm).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.02 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 102819
TUB AND SHOWER ENCLOSURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Framed tub and shower doors; enclosures.

B. Semi-frameless tub and shower doors; enclosures.

1.02 RELATED REQUIREMENTS

A. Section 224000 - Plumbing Fixtures: Tubs and Shower receptors.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

C. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

D. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

E. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.

G. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2025a.

H. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.

I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

J. ASTM B138/B138M - Standard Specification for Manganese Bronze Rod, Bar, and Shapes; 2011 (Reapproved 2024).

K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

M. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.

N. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

O. ASTM C1036 - Standard Specification for Flat Glass; 2021.

P. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

R. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

S. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's literature for enclosure.

C. Shop Drawings: Indicate layout, dimensions, identification of components, and interface with adjacent construction.

D. Selection Samples: Two sets, representing manufacturer's full range of available metal, glass, cast polymer, and fiberglass materials and finishes.

E. Verification Samples: Two samples, minimum size of 2 by 3 inches (51 by 76 mm), representing actual material and finish of exposed metal, glass, cast polymer, and fiberglass.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products under cover and elevated above grade in manufacturer's unopened packaging until installation.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tub and Shower Enclosures:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Do not begin installation until supports and adjacent substrates are complete.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

B. Prepare substrates as recommended by the manufacturer.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings.

B. Fit and align tub and shower enclosure level and plumb.

3.04 ADJUSTING

A. Adjust tub and shower enclosure doors to operate smoothly.

3.05 CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove protective film and temporary stickers from exposed metal and glass surfaces.

3.06 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

1.02 RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 099123 - Interior Painting: Field paint finish.

C. Section 211200 - Fire-Suppression Standpipes: Cabinet enclosure for extinguishers.

1.03 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

2.02 FIRE EXTINGUISHER CABINETS

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 107113
EXTERIOR SUN CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Operable sun control devices for exterior applications:
   1. Sun control louvers.

1.02 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site ready for erection.

B. Package using methods that prevent damage during shipping and storage on site.

C. Store materials under cover and elevated above grade.

PART 2 PRODUCTS

2.01 SUN CONTROL LOUVERS

A. Description: Non-retractable, factory-finished rack arm assembly with operable louver tilt function; size and configuration as indicated on drawings.

B. General Requirements:
   1. Rack Arm: Extruded aluminum, factory assembled with pivot arms and associated hardware for operation of louvers.

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.

B. Do not install until after adjacent painting, roofing and masonry work has been completed.

C. Do not proceed with installation until related conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Set units level, plumb, with uniform joints, and aligned with building elements.

C. Separate dissimilar metals using concealed bituminous paint or non-absorbent gasket.

D. Anchor units to structure as indicated on drawings.

3.03 CLEANING

A. Clean exterior surfaces units of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.04 PROTECTION

A. Protect units after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION

SECTION 21 0000
FIRE SUPPRESSION INDEX

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Fire Suppression Work, as indicated on the Drawings and specified herein. Fire Suppression work indicated on the Drawings and/or specifications covering other trades shall conform to Division 21 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Fire Suppression systems, shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for fire suppression service and control connections to all the various items of equipment requiring fire suppression service throughout the project shown on the Contract Drawings (even if not shown on the Fire Suppression Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 FIRE SUPPRESSION DIVISION INDEX

21 0500 GENERAL FIRE SUPPRESSION REQUIREMENTS
21 1300 AUTOMATIC SPRINKLER SYSTEMS

PART 2 – PRODUCTS (Not used.)

PART 3 – EXECUTION (Not used.)

END OF SECTION

SECTION 21 0500
GENERAL FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: General Mechanical Requirements specifically applicable to Division 21 sections in addition to Division 1 - General Requirements.

B. Scope:

1. The work covered by this division consists of performing all operations in connection with the installation of fire protection systems including site utility work as indicated under this section. This entire section applies to all fire protection systems work and shall be coordinated with all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

2. The contract documents, including all mechanical, electrical, and plumbing drawings and specifications, are part of this specification by reference.

1.2 REFERENCES

A. Standard Requirements:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. The Contractor shall secure all permits and licenses for their work and shall pay all fees in connection with such permits and licenses.

D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from their failure to comply with codes and ordinances.

E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AABC Associated Air Balance Council

2. ADC Air Diffusion Council
435 North Michigan Ave.
Chicago, IL 60611

3. AGA American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209

4. AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004

5. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018

6. ASHRAE American Society of Heating Refrigerating and Air Conditioning Engineers
345 East 47th Street
New York, NY 10017

7. ASME American Society of Mechanical Engineers
345 East 45th Street
New York, NY 10017

8. ASPE American Society of Plumbing Engineers
960 Illuminating Building
Cleveland, OH 44113

9. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

10. AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

11. AWS American Welding Society
2501 NW 7th Street
Miami, FL 33125

12.	CISPI	Cast Iron Soil Pipe Institute 1499 Chain Bridge Road McLean, VA 22101
13.	FM	Factory Mutual System 1151 Boston-Providence Turnpike Norwood, MA 02062
14.	FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Building 197 Washington, DC 20407
15.	NBFU	National Board of Fire Underwriters 5530 Wisconsin Avenue, Suite 750 Chevy Chase, MD 20815
16.	NEC	National Electric Code (of NFPA)
17.	NEBB	National Environmental Balancing Bureau 8224 Old Courthouse Road Vienna, VA 22180
18.	NEMA	National Electrical Manufacturer's Association 2101 L Street, NW Washington, DC 20037
19.	NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
20.	NSF	National Sanitation Foundation Box 1468 Ann Arbor, MI 48106
21.	OSHA	Occupational Safety and Health Administration U.S. Department of Labor
22.	PDI	Plumbing and Drainage Institute 5342 Boulevard Place Indianapolis, IN 46208
23.	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 8224 Old Courthouse Road Vienna, VA 22180
24.	TIMA	Thermal Insulation Manufacturers Association Technical Services 1420 King Street Alexandria, VA 22314

25. UL Underwriters Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.

B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately, and their decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at their expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, they shall bear all extra expense involved.

C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.

D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect\Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.

E. The fire protection plans do not give exact details as to elevations of any ceilings, ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out their work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

F. Should the particular equipment which any Bidder proposes to install require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting their bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at their (the Contractor's) own expense.

G. The Contractor shall submit working scale drawings of all their apparatus and equipment which in any way varies from these specifications and plans which

shall be checked by the Architect/Engineer and approved before the work is started. Interference with structural conditions shall be corrected by the Contractor.

H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

I. Utilities: The location, size, and pressure of utility lines are shown in accordance with the data given this office by others. As Architect/Engineers, we cannot and do not guarantee the accuracy of this data. Each Bidder shall check and verify this data. The points of connection to utility lines are approximate only and shall be verified by each Bidder prior to submitting their Bid.

J. Site visit: The Contractor shall visit the site prior to bidding and satisfy themself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made on their behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy themself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

A. See contract documents for system descriptions.

1.5 PRIOR APPROVALS

A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by them is acceptable.

1.6 SHOP DRAWINGS

A. Shop drawings and/or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, valves, fire protection equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide them with as many review copies as they may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.

B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy themself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.

C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless they have, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve them from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, they shall state in their letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra cost is involved for making the change.

D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render them liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.

E. Shop drawings will be returned unchecked unless the following information is included: installation drawings, hydraulic calculations, complete details, and all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e. control valves) shall be typed on white paper inserts and placed in an appropriate tab. Complete data must be furnished showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

B. No review of the fire protection system shall be completed without all shop drawings, equipment, hydraulics, etc. being delivered as one package. No exceptions.

C. The following items shall be submitted for review by the Architect/Engineer but are not limited to:

1. Utilities Piping & Materials whether furnishes by the contractor or others.

2. Fire Protection Drawings & Hydraulic Calculations

3. Cross Connection Control Devices

4. Piping Material

5. Fire Protection Equipment – including alarm valve, tamper switch, etc.

6. Ductwork Shop Drawings – as part of fire protection drawings.

1.8 QUALITY ASSURANCE

A. General: Comply with Division 1.

B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.

C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install their work with relation to existing building conditions and shall be entirely responsible for the correctness of their work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.

D. The contract drawing depicts graphically the arrangement of piping. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.

E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, they shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to their work, and for the correct location of pipe sleeves.

G. Each Contractor shall coordinate their work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or

handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.

H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.

I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.

J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to ensure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in a 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at their expense.

K. Cutting and Repairing:

1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.

2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.

3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.

1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with nonshrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.

2. Unless otherwise noted, foundations shall be a minimum of 6 inches high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:

1. International Building Code.

2. Uniform Mechanical Code.

3. Uniform Plumbing Code.

4. Governing Fire Department Requirements

5. Utility Company Requirements

6. National Fire Protection Association Standards

7. NFPA 70 - National Electrical Code

8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

10. NFPA 13 - Sprinkler Systems

11. NFPA 101 - Life Safety

12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment

13. NFPA 25 – Standard for the Inspection, Testing & Maintenance of Water Based Fire Protection System

14. NFPA 24 – Stand for Installation of Private Fire Service Main and Their Appurtenances

O. Access Panels

1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1

B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.

C. Acceptance: Check and sign for materials to be furnished by others for installation under Division 15 upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.

D. Protection: Close ends of pipe and ductwork at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.

E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.

F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

A. Performance: All systems are to be rated at 7,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

A. General: Comply with Division 1.

B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

A. All fire protection equipment wiring, conduit, relays, interlocks, and all accessories required for a completely operational fire protection system shall be the complete responsibility of the fire protection contractor. The fire protection contractor has the option to hire the project electrical contractor to install wiring and conduit. Refer to Specification Section 253000 for coordination requirements between mechanical, electrical, and controls subcontractors.

B. Electrical items such as disconnect switches and motor starters associated with equipment provided by all Mechanical Divisions, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.

C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, they shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

D. All motors shall meet all the requirements of all Electrical Divisions.

1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise,

motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature is of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: **Hazardous Area - Authorized Personnel Only.**

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Mechanical Contractor shall furnish to the Owner a bound manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems.

B. The Mechanical Contractor shall also provide training as required by Section 23 0100 to the Owner’s operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, they agree to the above.

1.17 WARRANTY AND SERVICE PROGRAM

A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full-service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).

B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.

C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.

D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.

1. Clean strainers in piping.

2. Fans and/or pumps be lubricated and oiled once every four (4) months.

3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.

4. All equipment manufacturer's service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

A. It shall be the responsibility of this Contractor to properly drain and flush all pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at their expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by them under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at their expense, without

expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.

B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four-pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetration is and the size of the opening.

1.22 PIPE SLEEVES

A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inches, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inches in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inches, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:

1.	Pipe up to and including 2"	3/8" rods
2.	Pipe 2-1/2", 3" and 3-1/2"	1/2" rods

3.	Pipe 4" and 5"	5/8" rods
4.	Pipe 6"	3/4" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:

1.	Pipe up to and including 1-1/4"	8'
2.	Pipe 1-1/2" and 2"	10'
3.	Pipe 2-1/2" and 3"	12'
4.	Pipe 3 1/2” and 4”	14’
5.	Pipe 5” and 6”	16’

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:

1.	Pipe up to 3/4" in size	5'
2.	Pipe 1" and 1-1/4"	6'
3.	Pipe 1-1/2" and larger	10'

E. There shall be a hanger within 2 inches of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Expansion bolts shall be Ackerman-Johnson or Hilti.

H. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

A. Not used.

1.25 ISOLATION

A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

Motor HP	Equipment Room
Up to 5	90%
7-1/2 to 15	93%
20 to 40	95%
50 to 100	97.5%

D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate, or may be unhoused stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

A. Before completion of this project, the Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.

B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.

B. Alignment: All installed pipelines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.

C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed, and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.

D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.

E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.

F. Welding: Refer to Paragraph 1.29 of this section of these specifications.

G. Bending: No bending of pipe will be permitted.

H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural

members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.

J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.

K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.

1. Those in non-hazardous service, such as water, shall discharge directly to outside.

2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.

3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.

L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.

M. Joints

1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.

N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.

O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

1.29 WELDING

A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:

1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to their proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.29.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is open to view. The sample weld should be prepared using a 6-inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector,

shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.

3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water (liquid lines only) at a sufficient flow rate and period of time, to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

B. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.

C. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.

D. Pressure Ratings: These tests shall not be used to establish pressure ratings.

E. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating. Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system

F. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

G. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.

H. Testing: Fire protection water piping shall be tested hydrostatically at the test pressures specified and duration required by NFPA. Leaks shall be located by soap testing.

I. Test Report

1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay or absence of coordination.

1.32 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. They shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

A. The Fire Protection Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned and the entire system shall be delivered in a perfect, unblemished condition.

1.35 PAINTING AND IDENTIFICATION

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.

B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave their equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.

C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during the painting operation.

D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inches in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or their representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at any time requested by the Architect/Engineer (or their representative) during the construction or warranty periods.

END OF SECTION

SECTION 21 1300
AUTOMATIC SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This specification, in conjunction with the contract drawings and all other specifications indicate materials and operations required for the installation of automatic sprinkler systems, including design, shop drawings, equipment, underground supply system, pipe and fittings above ground, fire department connections, sprinkler systems, guard rail, operating instructions, identification, tests, and sterilization of piping and system.

B. Any variation of the specification's intent or apparent conflict from this specification shall be submitted to the Architect/Engineer for written response. The response shall be incorporated into the drawings and shall be the final word on the item. The Contractor shall incorporate any change at no charge to the Owner.

1.2 REFERENCES

A. This specification section is not limited to the following specification:

21 0500 GENERAL FIRE SUPPRESSION REQUIREMENTS
22 1000 PIPE AND PIPE FITTINGS

B. The current editions of the following standards are a part of this specification.

1. National Fire Protection Association (NFPA) Standards.
   a) 13 Standard for the Installation of Sprinkler Systems.
   b) 70 National Electrical Code.
   c) 72 National Fire Alarm Code.
   d) 25 Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems.

2. American Water Works Association Standard Specifications.
   a) C600 Standard for the Installation of Ductile-Iron Water Mains and Their Appurtenances.
   b) C150 Ductile-Iron Pipe
   c) C110 Ductile-Iron and Gray Iron Fittings.
   d) C111 Rubber Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.
   e) C151 Ductile Iron Pipe Centrifugally Cast for Water
   f) C104 Cement-Mortar Lining for Ductile-Iron and Gray Iron Pipe and Fittings.
   g) C500 Metal Seated Gate Valves for Water Supply Service.
   h) C601 Standard for Disinfecting Water Mains.

C. Underwriters' Laboratories, Inc. (UL), Publication: Fire Protection Equipment List.

D. Factory Mutual System Publication: Approval Guide.

E. American Insurance Association Publication: Internal cleaning of sprinkler piping (GP-4).

1.3 SYSTEM DESCRIPTION

A. Design

1. The designer of the fire protection systems shall meet one of the requirements below.
   a) A registered Professional Fire Protection Engineer in the State of New Mexico.

2. The contractor is responsible for the design and installation of the fire protection system in accordance with these specifications and the contract drawings. The Contractor shall coordinate with architectural, civil, mechanical, and electrical, design and construction documents, to ascertain the required information, to affect a properly designed fire protection system for the building construction and occupancy classification.
   a) The contractor is responsible to design the automatic sprinkler system in accordance with these specifications and the contract drawings. The contractor shall refer to all architectural, mechanical, and electrical drawings, to ascertain the required information, to affect a properly designed sprinkler system for the building construction and occupancy classification.

3. The design of fire protection systems shall be complete with all necessary accessories for proper operation and shall include seismic support details.

4. The fire protection water supply lines, controlling devices, protective devices, alarm systems, supervisory devices, and related equipment shall be compatible so that all equipment will function together as specified.

5. The design shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the referenced codes and standards in Section 1.3, “References,” except where otherwise noted on the drawings or specified herein.

6. The Contractor shall produce design drawings that indicate the extent and arrangement of the fire protection system.

7. The contract drawings indicate the extent and general arrangement of the automatic sprinkler systems.

B. Spacing and Pipe Sizing

1. Unless otherwise specified or shown on the drawings, the sprinkler system shall be a wet pipe system, utilizing a Light Hazard hydraulic design.

2. Hydraulically system shall be designed on the contract drawings having the following characteristics:
   a) The design area shall be the hydraulically most demanding "rectangular area" having a dimension parallel to the branch lines equal to 1.4 times the square root of the area of sprinkler operation.
   b) Where the design area includes a corridor or tunnel protected by a single row of sprinklers, the maximum number of sprinklers that need be calculated is 10, unless openings into the corridor are unprotected by fire rated construction.
   c) Maximum water flow velocity shall not exceed 20 feet per second in any sprinkler system piping of hydraulically designed systems.
   d) The hose allowance shall be added to the sprinkler requirement at the point(s) where the hose station(s) connect(s) to the sprinkler system. The selected hose station(s) shall be within or nearest to the area of sprinkler application.
   e) Hydraulic design shall be based upon the water supply data shown on the drawings or obtained from the local Municipal Water Department.
   f) Hydraulic calculation methods shall be used as a minimum for Light Hazard, wet-pipe systems, unless otherwise specified. The minimum operating area allowed shall be either 1500 feet^2 or the entire area for smaller systems. No allowances or reductions shall be permitted without written approval from the Architect/Engineer.
   g) Extend all (regardless of job size, and including modifications, etc.) hydraulic calculations back to the effective point of connection (ring-main) of the sprinkler lead-in to the fire water main supplying the building, unless indicated on the contract drawings.
   h) The distance between sprinklers either on branch lines or between branch lines shall not be less than 6-foot distance apart.

C. Seismic Protection

1. Seismic protection for automatic sprinkler systems is required for all new systems. Modifications to existing systems shall require seismic protection when indicated on the contract drawings.
   a) For modifications to existing systems, seismic protection will be required for only that portion of the system being modified, the feedmain supplying the modification area, and the riser for that area.
   b) Seismic separation joints are required in areas separating the modified area of the sprinkler system and that area which is not to be upgraded for seismic protection.

c) The installation guidelines for seismic protection in NFPA 13 shall be used. Where an alternative method (other than NFPA 13) of providing seismic protection of a sprinkler system is to be used, only UL Listed or FM Approved material shall be permitted. The alternative method shall have a design based on a dynamic seismic analysis certified by a registered Professional Engineer in the State of New Mexico and the registered PE shall stamp all drawings.

D. Standpipes

1. Standpipes, where shown on the drawings, shall be installed as Class I system per NFPA 14. Hydraulic calculations are required for all wet standpipes serving two or more hose stations.

E. Protection of Areas Subject to Freezing

1. All anti-freeze systems require the installation of a reduced pressure backflow prevention (RPBFP) device. If a RPBFP is installed on the entire sprinkler system, then no additional RPBFP is required for the anti-freeze system.

2. Gridded or looped dry pipe or preaction systems are not allowed. The design for these systems shall be of the conventional tree design.

F. Manifolding of sprinkler risers to one single sprinkler lead-in shall not be permitted.

G. Fire Department connections shall be as follows:

1. Install Fire Department connections, where shown on the drawings.

2. When the sprinkler system hydraulic demand (not including exterior hose demand) exceeds 1000 gpm, a 6-inch 3-way Fire Department connection shall be provided.

3. A single fire department connection shall be provided to supply all fire protection systems for a building that has greater than 5 sprinkler risers.

1.4 SUBMITTALS

A. Shop Drawing Submittals

1. Provide as required by Division 1, Descriptive Submittals, to the Architect/Engineer.

2. As soon as practicable after award of contract and prior to fabrication, contractor shall submit to the ARCHITECT/ENGINEER for approval, complete shop drawings, manufacturers' catalog data, system and component operating instructions and hydraulic calculations for the sprinkler system and underground piping shown on plot plans.

3. NO INSTALLATION WILL BE PERMITTED prior to the Architect/Engineer approval of complete shop drawings.

B. Presentation:

1. New Sprinkler Systems
   a) New drawings shall be identical in size, scale, orientation, and title as the original building construction contract drawings unless otherwise noted.

C. Drawing Details

1. Unless otherwise specified or shown on drawings, new floor plans and full height cross sections shall be drawn at a scale of 1/4" = 1'-0" and arranged such that the north arrow points to the top or to the left of the sheet. Other details shall be drawn to a larger scale, as required. Riser elevation details shall be drawn to a scale of 1/2" = 1'-0"

2. No more than one building or one floor shall be shown on a sheet.

3. Drawings shall show all details required and recommended by NFPA 13, for "Working Plans" in addition to the following:
   a) A name or room number shall appear in each room; and a scaled key plan, oriented the same as the floor plan, shall appear on each partial plan sheet.
   b) All obstructions to the sprinkler layout shall be shown, including but not limited to, HVAC ducts, lighting, electrical buss ducts.
   c) Building column lines shall be labeled.
   d) Existing work and new construction shall be clearly differentiated on the drawings (where applicable).
   e) All lines and details shall be drawn; "opposite hand" or mirror image IS NOT acceptable -- separate drawings shall be made.
   f) All pipe lengths shall be shown, center-to-center of fittings.
   g) Where more than one type of pipe is used, each piece of pipe shall be identified as to type on the drawings.
   h) The drawings shall be kept neat and well arranged, with legible notes and figures to permit photographic reduction to one half size or smaller.
   i) No lettering shall be smaller than 1/8 inch.

D. Plot Plans

1. Plot plans shall be drawn to 1" = 20'-0" unless otherwise shown on the contract drawings.

2. Previous references to orientation, legibility, and lettering shall apply.

3. Plot plans shall show all details required by NFPA 13 and 24.

E. As-Built Drawings

1. Upon completion of the work, the Contractor shall revise all drawings to agree with the construction as actually accomplished. The notation "As-Built" shall be entered in the revision block, dated and initialed.

2. The As-Built drawings shall show the entire sprinkler system as it existed at the completion of the contract work.

3. The original As-Built drawings shall be delivered as directed by the Architect/Engineer.

1.5 ALTERNATES/ALTERNATIVES

A. Where specific manufacturers or model numbers are mentioned in these specifications, proposed substitutions shall be included in the submittal package furnished to the Architect/Engineer for approval after contract award.

B. If UL-listed or FM-approved equipment is commercially available, none other will be approved.

1.6 WARRANTY

A. All sprinkler system components furnished under this contract shall be guaranteed against defective design, materials, and workmanship for the full warranty time, which is standard with the manufacturer and/or supplier, but in no case less than one year from the date of system acceptance.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Materials and equipment used in the installation of the sprinkler system shall be new and listed by the UL Fire Protection Equipment Directory or the FM Approval Guide, latest edition. The standard products and the latest design of the manufacturer shall be used, and installed per their listing, approval, or manufacturer recommendations. All products listed or approved by prior editions of the UL Director of FM Approval Guide will not be acceptable, if not listed or approved in the most recent edition of the directory or approval guide.

B. Where two or more units of the same class of equipment are required, these units shall be products of the same manufacturer (e.g., couplings shall be from one manufacturer.) All materials shall be installed per their listing or approval and per the manufacturer’s recommendations and specifications.

C. New dry-pipe, preaction and deluge sprinkler systems shall be provided with the following devices:

1. A FM approved or UL listed air dryer for the sprinkler control air supply for dry-pipe and preaction systems.

2. A FM approved or UL listed air dryer for the air supply to any pneumatic tubing used for heat detection (if used).

3. Where air compressors are used, the air compressor will come equipped with a minimum 10-gallon tank. Nitrogen bottles are permitted to supply nitrogen pressure to systems smaller than 125 gallons in size. Where the system capacity is larger than 125 gallons, air compressors shall be used.

D. Tape for screwed joints shall be minimum ½-inch wide.

E. Corrosion protection tape shall be Scotchwrap 51, manufactured by 3M Company or approved equivalent.

2.2 SPRINKLERS

A. Types

1. Unless otherwise specified, allowed per other section of this document, or shown on the drawings, sprinklers shall be nominal, ½-inch orifice, automatic, closed-head sprinklers rated at 155ºF (68ºC) Quick Response, frangible bulb type fusible element.

2. Higher temperature rated sprinklers shall be installed where heads are exposed to high ambient temperature, exposed to the direct rays of the sun, beneath skylights or windows and installed in the vicinity of heating equipment, or in attics. The sprinkler temperature chosen shall be a minimum of 50ºF above the maximum ambient temperature, and no greater than 100ºF above the ambient conditions, unless specifically directed by NFPA 13.

3. Rooms containing electrical equipment shall be protected with sprinklers having the following minimum temperature ratings, but no less than 50ºF above normal ambient room temperature:
   a) Computer rooms 155ºF (68ºC) QR

4. On-Off sprinklers are not allowed. FM approved or UL listed on-off sprinkler systems, like the Viking FireCycle (or approved equal), are allowed.

5. Quick Response (QR) sprinklers, where specified on the drawings, shall have a Response Time Index (RTI) of 50 or less in English units and 28 or less in metric units.

6. Sidewall sprinklers shall be Underwriters' Laboratories listed or Factory Mutual approved for Ordinary Hazard Occupancy.

7. Extended coverage sprinklers are not allowed.

8. Only sprinklers with a "Belleville" type seal shall be used. No O-Ring sealed sprinklers shall be allowed either in "crush" seals or "radial" seal

styles. Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism.

B. Protection Against Freezing

1. Horizontal dry sidewall sprinklers shall be used in lieu of antifreeze loops for narrow unheated areas adjacent to heated areas, such as docks, covered loading platforms, vehicular air locks, elevator hoistways, and gas bottle or other storage sheds.

2. The depth of the protected space shall not exceed 10 feet.

3. The dry sprinkler shall extend a minimum of 12 inches into the heated space. For refrigerated spaces, the length dry sprinklers shall extend into the heated space shall be as specified by the ARCHITECT/ENGINEER.

C. Position and Finish

1. Sprinklers installed on exposed piping shall be manufacturer's standard finish pendent sprinklers. Sprinklers and escutcheons installed below dropped ceilings shall have a finish matching the color of the ceiling tile. Only factory applied finishes shall be acceptable. If the factory has a finish that cannot match the ceiling tile color, standard finish sprinklers are allowed.

2. In rooms where sprinkler heads penetrate a suspended ceiling, only quick response, semi-recessed or recessed sprinklers are acceptable. Standard pendant sprinklers with "cup and skirt" escutcheons, one-piece escutcheons, or flush or concealed sprinklers are not allowed.

3. EXCEPTION: On existing installations only, where sprinkler head relocations or small modifications (less than 20 heads) take place, the new sprinklers and escutcheons shall match the existing sprinklers.

4. Escutcheons, head guards, and water shield from the supplied sprinkler manufacturer shall be used solely with the installed sprinkler. No after market escutcheons, head guards, or water shields are allowed.

5. Head guards shall be two-piece, universal attachments, bolted in place on the sprinkler. "Snap-on" one-piece units are not allowed.

2.3 PIPE

A. Pipe for installation above ground shall be metal conforming to the requirements of NFPA 13. No plastic pipe is permitted in any location whether or not permitted by NFPA. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval and meet the following requirements:

1. Mechanical rolled groove pipe or cut groove pipe shall not be used at fire protection risers or for segmented arcs. Use swing jolt at locations of segmented arcs.

2. Unless otherwise specified, the minimum steel pipe wall thickness shall be Schedule 10 for pipe sizes 3 inches or larger. Pipe sizes smaller than 3 inches shall be Schedule 40. Threaded or cut groove steel pipe shall be Schedule 40 for sizes less than 8 inches and a minimum of Schedule 30 in sizes 8 inches and larger for pressures up to 300 psi.

3. Mechanical rolled groove pipe or welded pipe shall be a minimum of Schedule 10 for sizes 3 inches up to 5 inches, 0.134-inch wall thickness for 6 inches, and 0.188-inch wall thickness for 8- and 10-inch pipe for pressures up to 300-psi.

4. Steel pipe, installed for the water motor alarm line, piping from drain line valves and inspector's test valves, dry pipe and preaction sprinkler system piping, and where pipe is exposed to outdoor weather, etc., shall be internally and externally galvanized. Galvanized fittings are required where galvanized piping is used. Any piping leading to a pressure-operated waterflow indication device shall also be galvanized. The starting point is on the alarm connection to the alarm check valve.

B. Mechanical rolled groove pipe or cut groove pipe shall not be used at fire protection risers or for segmented arcs. Use swing jolt at locations of segmented arcs.

C. Braided stainless steel (or other materials) flexible sprinkler drop shall not be used to install sprinklers.

2.4 PIPE FITTINGS

A. Pipe fittings for installation above ground shall conform to the requirements of NFPA 13 and shall be FM approved or UL listed.

1. Mechanical groove couplings are required on all 4 inches and larger pipe.

2. Plain-end pipe couplings shall not be used in any new installation.

3. Galvanized pipefittings shall be installed where galvanized piping is specified.

4. Welded branch outlet fittings (weld-o-lets, groove-o-lets, etc) shall be minimum Schedule 10 for pipe sizes 3 inches or larger. Pipe sizes smaller than 3 inches shall be Schedule 40 standard wall pipe thickness. Welded outlets shall be UL listed or FM approved, affixed with the UL or FM identification stamps, and pressure rated for 300-PSI maximum.

5. Adjustable, two-piece drop nipples shall not be used. All drop nipples shall be one-piece, non-adjustable units with a minimum 1-inch diameter.

2.5 PIPE HANGERS, SUPPORTS AND SEISMIC BRACING

A. Pipe hangers, and hangar assemblies shall be UL listed of FM approved.

B. C-clamps and beam clamps shall have lock nuts and retaining straps, or clips, and pipe rings shall be of the solid-band adjustable swivel type.

C. Provide rod-ceiling plates at finished ceilings for coach screw rods, expansion shields, and toggle hangers.

D. All seismic bracing devices and flexible couplings shall be specifically UL listed or FM approved and installed per their listing or approval.

E. When fastening hangars to purlins, bolt-through fastening methods shall be used. Beam clamps with restraining straps shall not be used in any circumstance.

F. All seismic brace members shall be continuous. Under no circumstances shall members be spliced or offset.

G. The use of “Sammy” hangers shall not be used through “B-Deck” at the roof level. “Sammy” screws may be used in other locations as appropriate to manufacturer installations requirements and details.

H. Tension-only seismic bracing systems shall meet the following.

1. The tension-only system shall be UL or FM approved for seismic service, and installed in accordance with listing limitations and installation instructions.

2. A means to prevent vertical motion due to seismic forces shall be installed at the brace location.

3. Two tension only braces shall be installed in opposing directions at each brace location.

2.6 FIRE PROTECTION CHECK VALVES

A. Check valves in sprinkler system shall be UL listed or FM approved, have hand hole covers to provide adequate access to facilitate inspection and repair, without the removal of the valve from the system, and shall be listed for installation in the vertical or horizontal position. Wafer check valves are unacceptable. All check valves shall have a working water pressure of 250 PSI.

B. Alarm check valves (wet pipe, dry pipe, deluge, preaction, etc.) shall be provided on all sprinkler risers and have the following.

1. The alarm check valve (ACV) shall be equipped with a removable hand hole cover assembly, and shall be listed for installation in the vertical or horizontal position.

2. The ACV shall be equipped with gauge connections on the system side and supply side of the valve clapper.

3. ACV trim piping and fittings shall be internally and externally galvanized.

4. Ported alarm connections on the ACV shall be to a retard chamber to absorb variable pressure surges.

5. Only “Flange x Flange” ACV devices shall be installed.

6. Wet-pipe systems shall use a variable-pressure alarm check valve. Plain-type check valves are not allowed. Sprinkler alarm valve shall be equipped with an external bypass to eliminate false water flow alarms.

7. Dry-pipe valves shall be a positive latching clapper, differential type dry valve and air pressure to water pressure area differential shall be approximately 5 to 1.

8. Deluge valves shall be externally re-settable by hydraulic means, and shall employ a positive vent on the priming line to ensure that the deluge valve will not prematurely reset.

C. Backflow prevention devices shall be installed on all sprinkler systems as follows.

1. A reduced pressure backflow prevention assembly (RPBFP) shall be installed to prevent cross-connection contamination between potable water systems and any fire sprinkler system, at the service connection for the fire sprinkler system.

2.7 FIRE PROTECTION INTERIOR CONTROL VALVES

A. Each system shall have interior control valves as follows:

1. A control valve shall be installed for isolation of each floor of multistory buildings.

2. Interstitial spaces, in-rack sprinkler systems, mezzanines, etc., shall have control valves for system isolation at the feed-main.

3. All control valves shall be provided with an electric valve supervision device, connected to the Fire Alarm System.

4. All inside control valves shall be OS&Y. Butterfly valves are not permitted. Valves shall be manufactured in accordance with AWWA Standard C500, and have a clear waterway equal to the full nominal diameter of the valve. Valves shall be provided with a handwheel, with arrow cast in metal to indicate direction of opening.

2.8 SUPERVISORY DEVICES

A. When specified on the contract drawings, supervisory devices shall be compatible with the Fire Alarm System.

B. Provide the equipment listed below.

1. Electric valve supervision switches shall be installed for all internal (inside) and external (outside) fire protection valves 2-1/2 inches or larger.

The devices shall be electrical; single-pole, double-throw; with normally closed contacts and include design that signals controlled valve is in other than fully open position.

2. For wet pipe sprinkler systems, install vane-type waterflow alarm initiation devices with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts and complete with tamperproof cover that sends signal if removed.

3. All vane type waterflow alarm initiation devices shall be equipped with an adjustable delay of audible alarm initiation. Adjustment range shall be from 0 to 120 seconds. Vane type waterflow switch shall be Potter Model VSR-F or approved equal.

4. Waterflow vane-type alarm initiation devices shall be labeled as to the correct orientation of flow when mounted on system piping. When drilling of the system riser it is necessary to mount flow switch, the drilled out disc (coupon) shall be retrieved and attached to the mounting u-bolt of the flow switch.

5. Where pressure operated waterflow alarm initiation devices are used, any valve installed upstream of the device on the alarm line shall be electrically supervised, using the Potter Model BVS or approved equal. Pressure operated alarm initiation devices shall be an electrical-supervision type, waterflow switch with retard feature. The device shall include single-pole, double-throw, normally closed contacts and design that operate on rising pressure and signals waterflow.
   a) EXCEPTION: Where the waterflow alarm initiation device is used only for the purpose of an outside electric bell in lieu of the water motor gong device.

6. Low-pressure supervision shall be installed on all dry pipe or preaction systems and be connected into the Fire Alarm System.

7. Any device that is to be installed in a hazardous location defined by NFPA 70 shall be rated for occupancy.

2.9 FIRE DEPARTMENT CONNECTIONS

A. Fire Department connections shall have a minimum of two 2-1/2 inch inlets with National Standard Hose (NWSH) threads, internal double clapper check valve, brass plugs, and attached chains.

B. Fire Department connections shall be installed at each new alarm check valve, dry pipe valve, deluge and preaction valve and standpipe, unless the sprinkler system is supplied by a Fire Department connection in the yard main, or as otherwise noted in NFPA 13

C. The completed installations shall include a metal sign or escutcheon plate, with raised lettering, marked “FIRE DEPARTMENT CONNECTION STANDPIPE-

AUTO S0KR," 'AUTOMATIC SPKR," or "STANDPIPE," as appropriate. Additional signs for systems such as foam water sprinkler systems or other alternative designed systems, as required by other NFPA Standards, shall also be provided by the Contractor where required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Responsibilities

1. The Contractor is responsible for the installation of the automatic sprinkler system in accordance with these specifications and the contract drawings. The Contractor shall coordinate with architectural, mechanical, and electrical, design and construction documents, to ascertain the required information, to effect a properly designed and installed sprinkler system for the building construction and occupancy classification.

2. The installation of the automatic sprinkler system shall be complete with all necessary accessories for proper operation and shall be accomplished by a licensed sprinkler contractor or licensed company regularly engaged in this type of work, and in accordance with requirements of the National Fire Protection Association Standards (NFPA).

3. An individual with a minimum NICET Level II shall supervise the installation.

4. The fire protection system installation shall be coordinated with the other trades (mechanical, electrical and structural, etc.).

5. The installation shall comply with all mandatory, advisory interpretations, and recommended applicable rules of the latest editions of the standards listed in Section 1.3 of this document, except where otherwise noted on the drawings or specified herein.

B. Contamination and Obstruction Prevention

1. Pipe interiors shall be kept free of debris.

C. Pipe and Fittings Aboveground

1. Pipe, fittings, and hangers shall be installed where shown on the drawings and in accordance with the requirements of NFPA 13.

2. Overhead sprinkler piping, drain and test piping, fire department connection piping, etc. installed through exterior walls shall be galvanized. All sprinkler piping shall be substantially supported from building structure and only UL listed or FM approved type hangers shall be used. Sprinkler lines under ducts shall not be supported from ductwork but shall be supported from building structure (with trapeze hangers where necessary).

3. Flanged Fittings or Mechanical Groove Couplings
   a) Flanged fittings or mechanical groove couplings shall be used at the base of risers, in the risers of multiple-story sprinkler systems at each floor-system connection, and in feed main. Flanged fitting shall be used for alarm valve assemblies.
   b) A flanged tapered reducer shall be installed at the flange and spigot piece when riser is smaller than the underground supply line.
   c) Pipe shall be installed straight and true with no greater deflection at mechanical groove pipe couplings than is recommended by the manufacturer.
   d) Pipe end couplings are not acceptable.
   e) Only rigid-type mechanical couplings shall be used, unless specifically directed by NFPA 13 such as for specific seismic locations. Only in those areas identified by NFPA 13 where flexible type mechanical couplings are specified will the use of flexible couplings be permitted. All other parts of the system shall use rigid-type mechanical groove couplings.

4. Pipe Hangers and Anchors
   a) Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.
   b) Offsets in hanger rods will not be permitted.
   c) Concrete anchors shall be installed by drilling and installing a UL listed or FM approved anchor. Explosive driven fasteners as a method of installing anchors or hangers shall not be permitted.
   d) Supports, hangers, braces, etc., shall be attached to the building primary structural members only.
   e) When fastening hangers or braces to bar joists, the fastener shall be located within 4 inches of the panel point on the bar joist.
   f) All piping larger than 4 inches in diameter shall be supported from a minimum of two-bar joists when run parallel to a bar joist.

5. Welded Joints
   a) Welded joints are acceptable when shop fabricated in conformance to provisions of NFPA 13.

6. Screwed Joints
   a) Teflon paste and tape shall be used as pipe-joint compound at screwed joints.

7. Bushings
   a) Bushings shall not be permitted.

8. Control Valves
   a) Control valves shall be provided with identification signs describing the areas protected. Where the valve location is concealed above the ceiling, a sign below the ceiling shall indicate the valve location, and identify the protected area.

9. Wall, Ceiling, and Floor Penetrations
   a) Pipe sleeves shall be installed and properly secured in place at all points where sprinkler piping passes through concrete or masonry construction. Sleeves through all walls and floors shall provide adequate clearance for slight movement of the piping. The guidance in NFPA 13 guidance for seismic areas shall be followed.
   b) Sleeves for pipes passing through floors of concrete or waterproof construction shall project 3 to 6 inches above floors to prevent leakage. Sleeves through walls shall be cut flush with each surface unless otherwise specified. Sleeves shall be caulked to make penetration watertight.
   c) Unless otherwise specified, sleeves shall be of Schedule 40 steel and a minimum of two pipe sizes larger in diameter than the passing pipe.
   d) Holes through walls, floors, and ceilings of other than concrete or masonry construction shall be large enough to accommodate pipe expansion. Holes through existing concrete floors and walls shall be core drilled to provide clean, neat holes. Spaces between pipe and sleeve or pipe and opening for floors and exterior walls shall be filled with a non-hardening sealant material and made watertight.
   e) Where fire rated barriers are penetrated, a UL listed fire barrier system shall be installed to retain the fire resistance rating of the barrier.
   f) Escutcheons shall be provided at wall, ceiling and floor penetrations of piping in occupied areas.

10. The cutting of structural members for the passage of sprinkler piping or for pipe-hanger fastenings is not permitted.

11. Joints
    a) Joints shall be made in accordance with the requirements of NFPA 13.
    b) Joints shall be left exposed until final inspection and testing have been witnessed.
    c) Swing joints are preferred for connecting pendent sprinklers to branch lines.

12. Dielectric unions shall be used to connect dissimilar metals (such as steel to copper) to prevent electrolytic action.

3.2 SPRINKLER SYSTEM ALARM CHECK VALVES

A. Alarm Check Valves (ACV) shall be provided with internally and externally galvanized trim piping and fittings, pressure gages, a retarding chamber, water motor gong, alarm switch, testing bypass, and all necessary pipe, fittings and accessories.

B. The retarding chamber drain line shall be piped independently of the main drain line.

C. The drain line from the water motor gong shall be piped to discharge through the wall as close to the grade line as possible.

D. Piping between the ACV and a pressure actuated alarm-initiating device shall be galvanized piping not less than 3/8-inch nominal pipe size.

E. Piping supplying the retard chamber, water motor gong, and water motor gong drain shall be galvanized. Galvanized fittings are to be used where galvanized piping is required.

3.3 SPRINKLERS

A. Pendent sprinklers below ceiling shall be aligned, and parallel to ceiling features, walls, etc. In areas without a suspended ceiling, install sprinkler piping as high as possible, using necessary fittings and auxiliary drains to maintain maximum clear headroom.

B. Where two sprinkler systems abut the pendent sprinklers shall be aligned in different directions to distinguish the boundaries of each sprinkler system.

C. Sprinklers under open grating shall be intermediate levels.

D. Sprinklers shall not be installed closer than 6 feet apart.

E. Dry pendant and horizontal dry sidewall sprinklers shall only be installed in screwed tee fittings.

F. Ceiling Areas: Where suspended ceilings are installed, the sprinkler contractor shall install pendent sprinklers as shown on the reflected ceiling plans. Where these plans do not specify the location of the pendent sprinklers, the Contractor shall obtain the reflected ceiling plans and design sprinkler locations at least six inches from ceiling tile edges, 2 feet 6 inches from HVAC supply and return louvers, dimension the locations, follow a repetitive pattern, and locate sprinklers along straight lines to the extent possible. Swing joints shall feed pendant sprinklers from 1-inch outlet tees in branch lines.

G. Stairs: Sprinklers shall be installed throughout stairways, and at every landing.

3.4 DRAINS

A. Two-inch drains shall be installed on all main risers and downstream of any interior sectional valves, and shall be piped to drain.

B. A pressure gage cock and approved gage shall be installed downstream of interior sectional valves of 4-inch size and larger. 3/4-inch valve auxiliary drains with standard hose threads and caps shall be installed at all low points in the system, where more than five sprinklers are trapped. Where the capacity of trapped piping exceeds 20 gallons, the overflow shall be piped to drain.

C. Inspector's test connections shall be installed on each sprinkler system as near the most hydraulically remote end of the system as possible. The orifice shall be sized to discharge a flow equivalent to the smallest orifice sprinkler in the system. The inspector's test valve shall be located not more than seven feet above the floor in a visible, easily accessible location. For antifreeze systems, the orifice shall be replaced by a plugged outlet.

D. In multi-story buildings where waterflow alarm devices are provided for each floor or where more than one alarm device is provided in a single sprinkler system, a separate inspector's test connection shall be provided for each alarm device. For convenience, in multi-level buildings where more than one inspector's test connection is required, all the valves shall be manifolded together at a single location on the grade floor, with a sight glass and a common drain line discharging outdoors.

E. Drains shall be piped to discharge to drain, and the discharge shall be visible either by open-end or sight drain fitting.

F. Drains and inspector's test connections through outside walls shall be run through the walls as close to the floor or grade line as possible, terminating with a 45-degree galvanized elbow turned down to splash blocks.

G. Concrete splash blocks, 18” x 18” x 4” minimum in size, shall be installed under each drain or test outlet. The top of the block shall be 1 inch above grade, with a slope of 1/2 inch per foot away from the building wall.

3.5 FIRE DEPARTMENT CONNECTIONS

A. The check valve and normally open automatic ball drip (ABD) shall be located at points where they will not be subject to freezing temperatures, and the discharge from the ball drip shall be piped to drain. The ball drip shall close when the flow of water through the valve is in the range of 4 through 10 gpm. All ball drips shall be rated at 175 psi. Use valve- drains in place of automatic ball drip drains when the static head of water above the ABD will exceed 11'6". Check valves shall be UL or FM approved and shall have bodies with the UL or FM stamp.

B. The Fire Department connection shall be installed between 18 inches and 36 inches above grade.

3.6 IDENTIFICATION

A. Control, drain, test, and alarm valves and zone waterflow switches shall be provided with identification signs of the standard design adopted by the automatic-sprinkler industry, or their equivalent.

B. A hydraulic data information nameplate shall be secured to the riser with durable wire, chain, or equivalent, directly above the controlling alarm check valve and shall include the following design data.

1. Building designation

2. Location of remote area

3. Design density

4. Area of application

5. System demand (gpm and psi at base of riser)

6. Data shall be permanently engraved on the nameplate as follows:
   a) Material shall be durable plastic or aluminum; Minimum height of lettering is 1/8”.

C. The Contractor shall furnish and place in a plastic envelope attached to each sprinkler alarm check valve riser, one complete set of typed or printed maintenance and operating instructions, a set of prints of the as-built working drawings and hydraulic calculations of the sprinkler system.

D. Contractor shall supply each riser with a cabinet containing maintenance and repair equipment (spare heads, wrench, etc.)

E. Each Contractor shall affix an identification tag on each system riser indicating

Name of the Contractor
Business Address of the Installing Contractor
Phone Number
24-hour emergency contact phone number

3.7 FLUSHING

A. Before connecting sprinkler systems to the main supply, each sprinkler supply line shall be flushed out thoroughly by the Sprinkler Contractor through an unrestricted opening not less than 4 inches in diameter. Minimum flowing quantities are specified in NFPA 13.

B. Failure to comply with this requirement shall necessitate flushing of the entire sprinkler system by the Contractor at no additional cost to the Owner.

C. A 4-inch temporary pipe or two 2-1/2" fire hoses shall be provided by the Contractor to discharge water to a suitable location, as designated by the Architect/Engineer.

3.8 TESTING

A. Aboveground Tests:

1. Prior to acceptance of the installation, the Contractor shall subject the system to the tests required by NFPA 13 for the completion of the Contractor's Material and Test Certificate. In addition, complete operating test of dry pipe, preaction, deluge, water-spray and foam water systems shall be performed.

2. Hydrostatic testing shall be performed before any ceiling is installed below the sprinkler piping. Each water control valve shall be fully opened and closed under water pressure to ensure proper operation.

3. Where sprinkler locations are roughed-in, using plugged drop nipples projecting below the level of the finished ceiling, the hydrostatic testing shall be performed two times.
   a) First, after the system is completed using the plugged drops, and before the ceiling panels are installed.
   b) Second, after the plugged drop nipples are cut to length for the finished ceiling, or replaced with other drop nipples of the correct length, and the sprinklers installed.

4. The addition of sodium silicate (also known as water-glass) and related substances before hydrostatic testing, to stop water leakage, is not permitted.

5. Pipe interiors shall be kept free of debris.

B. Alarm Testing

1. Contractor shall be responsible for testing new alarms and modified alarms installed under this contract. Defective alarms shall be replaced immediately.

3.9 PROTECTION AGAINST FREEZING

A. Sprinkler piping passing through any unheated spaces in, under, or outside buildings exposed to freezing, shall be protected as shown on the plans or in accordance with the methods specified in NFPA 13. Exposed to freezing is defined as any location where the temperature may drop below (40°F) 5°C at any time during the year.

B. Heating shall be provided for sprinkler-protected spaces in lieu of providing anti-freeze systems except where otherwise noted on the drawings or specified herein.

3.10 PROTECTION FOR BACKFLOW PREVENTION

A. A reduced pressure backflow prevention assembly (RPBFP) shall be installed on all new systems and where shown on the drawings for modifications to systems

to prevent cross-connection contamination between potable water systems and any fire sprinkler system. Install the RPBFP at the service connection for the fire sprinkler system or as noted on the contract drawings.

B. RPBFP assemblies shall be either FM approved or UL listed and be approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California (USC-FCCHR) and the International Association of Plumbing and Mechanical Officials (IAPMO).

C. Backflow prevention assemblies used or installed under this contract shall be tested by a “Certified Backflow Control Assembly Tester” who possesses a current (within three (3) years from date of issuance) certificate that confirms successful completion of an approved training course.

D. RDBFP assemblies shall be installed in accordance with AWWA Manual M14 requirements, or as directed by the SDR.

E. If RDBFP devices will be installed outside the building they must be in heated enclosures and with adequate space for inspection, tests and maintenance.

F. Adequate drainage shall be provided for RDBFP and meet the following:

1. Discharge shall be piped full size (of the relief valve) and extended to a drain.

2. Discharge piping shall be sloped 1/8” per foot and be Schedule 40, galvanized.

3. French Drains are not allowed.

G. The Contractor shall perform an operational test on any new backflow prevention assemblies used or installed under this contract.

3.11 PAINTING AND LABELING

A. Contractor shall paint those portions of fire protection as required by Painting Specification 099000. Labeling shall be as follows:

1. Sprinkler system (e.g., inspectors tests, drain valves) shall be labeled with all information required by NFPA Standard 13.

2. Labeling shall be accomplished with the use of permanently marked weatherproof metal or rigid plastic identification signs. The signs shall be secured with corrosion-resistant wire, chain, or other approved means. These signs shall be provided by the manufacturer, manufacturer’s representative, or installer of the sprinkler system.

3. Sprinkler riser shall be labeled with building and sprinkler system riser numbers. Labeling shall be accomplished with the use of “Brady” or approved equal self-sticking labels. The color and size shall contrast the surface that it is applied to.

3.12 DISINFECTION

A. Piping installed under this contract shall be disinfected per AWWA C651 before it is placed in operation, by using one of the following methods.

B. Continuous Feed Method

1. Place calcium hypochlorite in pipe sections when installing pipe or inject liquid chlorine into the system via the injection port. Pipe is filled with water and chlorine concentration shall remain at 10 mg/l for a minimum of 24 hours. During this time, all valves in new section will be cycled open and closed to allow for adequate disinfection. Valves connecting the new or repaired line with mains in active service shall remain closed to prevent chlorine pollution.

2. Samples shall be drawn at 1-, 4-, 8-, 12-, 16-, 20-, and 24-hour marks to determine the chlorine concentration. Acceptable tests are the N-diethyl-p-phenylenediamine (DPD) drop dilution method (AWWA C651, Appendix A) or the High Range Test Kit. The tests shall be done by the Contractor.

C. Slug Method

1. Similar to the continuous feed method. Follow AWWA C651. Chlorine concentration to be 100 mg/l for a minimum of 3 hours. During this time, all valves shall be cycled open and closed to allow for adequate disinfection. Valves connecting new or repaired lines with mains in active service shall remain closed to prevent chlorine pollution.

2. Samples shall be drawn every 15 minutes to determine concentration. Acceptable tests are the DPD drop dilution method or the High Range Test Kit. The tests shall be conducted by the Contractor.

D. Repairing or Cutting into Existing Mains

1. New interior piping surfaces shall be swabbed with a one-percent hypochlorite solution. The section being modified shall be subjected to a high chlorine disinfection process per AWWA C651. The concentration shall be a minimum of 300 mg/l for 15 minutes.
2. Samples shall be drawn before the chlorine is injected and every 5 minutes thereafter. Chlorine concentration shall be tested by the Contractor using the High Range Test Kit.

E. Flushing

1. After the lines have been chlorinated using one of the above methods, it becomes necessary to flush the lines with water until test sample indicates that the water is suitable for drinking. The residual chlorine concentration in the water is to be between 0.2 and 2.0 mg/l, as measured using a Low Range Test Kit.

F. Bacteriological Testing

1. All new and modified water lines require testing for coliform organisms per AWWA C651. The testing shall occur after successful chlorination and flushing of the lines. Samples shall be taken from the new line in sodium thiosulfate treated sterile bottles and analyzed as specified by APHA's Standard Methods for the Examination of Water and Wastewater.

2. Results shall be recorded with the original documentation of results attached. These will be used for auditing purposes.

3. Fire protection lines will not be accepted until a negative bacteriological test is performed. Lines will be chlorinated and flushed repeatedly, until such a negative test is accomplished.

END OF SECTION

SECTION 22 0000
PLUMBING INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Plumbing Work, as indicated on the Drawings and specified herein. Plumbing work indicated on the Drawings and/or specifications covering other trades shall conform to Division 22 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Plumbing systems shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for plumbing service connections to all the various items of equipment requiring plumbing or piping throughout the project shown on the Contract Drawings (even if not shown on Plumbing Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 PLUMBING DIVISION INDEX

22 0500	GENERAL PLUMBING REQUIREMENTS
22 0523	VALVES
22 0700	PIPING INSULATION
22 1000	PIPE AND PIPE FITTINGS
22 1113	DOMESTIC WATER SYSTEMS
22 1313	SOIL AND WASTE PIPING SYSTEMS
22 4200	PLUMBING FIXTURES

PART 2 – PRODUCTS (Not used.)

PART 3 – EXECUTION (Not used.)

END OF SECTION

SECTION 22 0500
GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: General Plumbing Requirements specifically applicable to Division 22 sections in addition to Division 1 - General Requirements.

B. Scope:

1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

A. Standard Requirements:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. The Contractor shall secure all permits and licenses for their work and shall pay all fees in connection with such permits and licenses.

D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from their failure to comply with codes and ordinances.

E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AGA American Gas Association
   1515 Wilson Boulevard
   Arlington, VA 22209

2. ANSI American National Standards Institute
   1430 Broadway
   New York, NY 10018

3. ASHRAE American Society of Heating Refrigerating and Air Conditioning Engineers
   345 East 47th Street
   New York, NY 10017

4. ASME American Society of Mechanical Engineers
   345 East 45th Street
   New York, NY 10017

5. ASPE American Society of Plumbing Engineers
   960 Illuminating Building
   Cleveland, OH 44113

6. ASTM American Society for Testing and Materials
   1916 Race Street
   Philadelphia, PA 19103

7. AWWA American Water Works Association
   6666 West Quincy Avenue
   Denver, CO 80235

8. AWS American Welding Society
   2501 NW 7th Street
   Miami, FL 33125

9. CISPI Cast Iron Soil Pipe Institute
   1499 Chain Bridge Road
   McLean, VA 22101

10. FM Factory Mutual System
    1151 Boston-Providence Turnpike
    Norwood, MA 02062

11. FS Federal Specification
    General Services Administration
    Specifications and Consumer Information Distribution Section (WFSIS)
    Washington Navy Yard, Building 197
    Washington, DC 20407

12. NBFU National Board of Fire Underwriters
5530 Wisconsin Avenue, Suite 750
Chevy Chase, MD 20815

13. NEC National Electric Code (of NFPA)

14. NEMA National Electrical Manufacturer's Association
2101 L Street, NW
Washington, DC 20037

15. NFPA National Fire Protection Association
Battery March Park
Quincy, MA 02269

16. NSF National Sanitation Foundation
Box 1468
Ann Arbor, MI 48106

17. OSHA Occupational Safety and Health Administration
U.S. Departm.ent of Labor

18. PDI Plumbing and Drainage Institute
5342 Boulevard Place
Indianapolis, IN 46208

19. TIMA Thermal Insulation Manufacturers Association
Technical Services
1420 King Street
Alexandria, VA 22314

20. UL Underwriters Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.

B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately, and their decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at their expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, they shall bear all extra expense involved.

C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or

specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.

D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect\Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.

E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out their work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

F. Should the particular equipment which any Bidder proposes to install require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting their bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at their (the Contractor's) own expense.

G. The Contractor shall submit working scale drawings of all their apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.

H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

I. Utilities: The location, size, and pressure of utility lines are shown in accordance with the data given this office by others. As Architect/Engineers, we cannot and do not guarantee the accuracy of this data. Each Bidder shall check and verify this data. The points of connection to utility lines are approximate only and shall be verified by each Bidder prior to submitting their Bid.

J. Site visit: The Contractor shall visit the site prior to bidding and satisfy themself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy themself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

A. Not Used.

1.5 PRIOR APPROVALS

A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by them is acceptable.

1.6 SHOP DRAWINGS

A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide them with as many review copies as they may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.

B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy themself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.

C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless they have, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve them from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such deviations to the attention of the Architect/Engineer, they shall state in their letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra cost is involved for making the change.

D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the

Contractor shall render them liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.

E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e., AHU/Air Handling Unit) shall be typed on white paper inserts and placed in an appropriate tab. Complete data must be furnished showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:

1. Pipe Insulation
2. Coils
3. Plumbing Fixtures and Trim
4. Cross Connection Control Devices
5. Pumps
6. Plumbing Equipment
7. Heat Exchangers
8. Flexible Pipe Connections
9. Heating Terminal Equipment
10. Roof Top Equipment
11. Fire Protection Equipment
12. Radiant Heating Equipment
13. Vibration Equipment and Calculations

1.8 QUALITY ASSURANCE

A. General: Comply with Division 1.

B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.

C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install their work with relation to existing building conditions and shall be entirely responsible for the correctness of their work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.

D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.

E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, they shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to their work, and for the correct location of pipe sleeves.

G. Each Contractor shall coordinate their work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.

H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.

I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.

J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to ensure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at their expense.

K. Cutting and Repairing:

1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.

2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.

3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.

1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with nonshrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.

2. Unless otherwise noted, foundations shall be a minimum of 6 inches high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:

1. International Building Code.

2. Uniform Mechanical Code.

3. Uniform Plumbing Code.

4. Governing Fire Department Requirements

5. Utility Company Requirements

6. National Fire Protection Association Standards

7. NFPA 70 - National Electrical Code

8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

10. NFPA 13 - Sprinkler Systems

11. NFPA 101 - Life Safety

12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment

13. International Energy Conservation Code 2021

O. Access Panels

1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1.

B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.

C. Acceptance: Check and sign for materials to be furnished by others for installation under Division 22 upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.

D. Protection: Close ends of pipe at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.

E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.

F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

A. Performance: All systems are to be rated at 7,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

A. General: Comply with Division 1.

B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to Specification Section 253000 for coordination requirements between mechanical, electrical, and controls subcontractors.

B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 22, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.

C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, they shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

D. All motors shall meet all the requirements of all Electrical Divisions.

1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations. Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature is of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: **Hazardous Area - Authorized Personnel Only.**

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Mechanical Contractor shall furnish to the Owner a bound (three (3) ring binder) manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems, as noted below:

1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

2. For Each Product System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.

3. Product Data: Mark each sheet to clearly identify specific product and component parts, and data applicable to installation. Delete inapplicable information.

4. Warranties and Bonds: Bind in copy of each.

5. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

6. Include color-coded wiring diagrams as installed for control system.

7. Operating Procedures: Include start-up, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

8. Maintenance Requirements: Include routine procedures and guide for troubleshooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

9. Provide servicing and lubrication schedule and list of lubricants required.

10. Include manufacturer's printed operation and maintenance instructions.

11. Include sequence of operation by controls manufacturer.

12. Provide original manufacturer's part list, illustrations, assembly drawings and diagrams required for maintenance.

13. Provide control diagrams by controls manufacturer as installed.

14. Provide charts of valve tag numbers, with locations and functions of each valve, keyed to flow and control diagrams.

15. Provide list of original manufacturer's spare parts and recommended quantities and to be maintained in storage.

16. Include Test and Balance (T&B) Reports as specified in Section 230593.

B. The Mechanical Contractor shall also provide training as required by Section 230100 to the Owner's operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, they agree to the above.

1.17 WARRANTY AND SERVICE PROGRAM

A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full-service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).

B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control

calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.

C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.

D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.

1. Clean strainers in piping.

2. Fans and/or pumps be lubricated and oiled once every four (4) months.

3. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.

4. All equipment manufacturer's service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at his expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by them under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at their expense, without expense to the Owner, at any time within one year after installation is accepted by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.

B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four-pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetration is and the size of the opening.

1.22 PIPE SLEEVES

A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2-inch above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inches, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inch in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inches, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:

1.	Pipe up to and including 2"	3/8" rods
2.	Pipe 2-1/2", 3" and 3-1/2"	1/2" rods
3.	Pipe 4"	5/8" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:

1.	Pipe up to and including 1-1/4"	8'
2.	Pipe 1-1/2" and 2"	10'
3.	Pipe 2-1/2" and 3"	12'
4.	Pipe 3 1/2” and 4”	14’

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:

1.	Pipe up to 3/4" in size	5'
2.	Pipe 1" and 1-1/4"	6'
3.	Pipe 1-1/2" and larger	10'

E. There shall be a hanger within 2 inches of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Expansion bolts shall be Ackerman-Johnson or Hilti.

H. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

A. Not used.

1.25 ISOLATION

A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a

manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

Motor HP	Equipment Room
Up to 5	90%
7-1/2 to 15	93%
20 to 40	95%
50 to 100	97.5%

D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate, or may be unhoused stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.

B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.

B. Alignment: All installed pipelines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.

C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed, and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.

D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.

E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.

F. Welding: Refer to Paragraph 1.29 of this section of these specifications.

G. Bending: No bending of pipe will be permitted.

H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.

J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.

K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.

1. Those in non-hazardous service, such as water, shall discharge directly to outside.

2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.

3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.

L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.

M. Joints

1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for

serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.

N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.

O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

P. Hanger Supports:

1. All hanger rods used to support piping, conduit, mechanical units, equipment, trapezes and other items shall be straight and installed plumb, regardless of length. Do not bend rods to adapt to sloped or rotated structural members, secondary support members or to sloped mounting holes on supported equipment. Contractor shall utilize available swivel, hinged, or rigid mounting techniques designed to accommodate a slope or rotation, or shall design a custom solution. Selected techniques for each application shall be submitted for approval prior to use.

2. Do not bend rods to circumvent an obstruction.

3. Loads on hanger rods shall be applied in direct tension. Do not apply compression, lateral or moment loads to hanger rods. Install bracing or additional supports to prevent hanger rod from incurring non-tension loading.

4. Do not create offsets in rods; use only in-line couplers, and only when length of coupled rod exceeds standard available length (typically 12 feet), or when full lengths cannot be placed in position. Provide additional horizontal bracing to prevent swaying of supported piping or equipment.

5. Do not straighten bent rods for subsequent use. If a rod becomes bent, cut off and discard the bent portion. Remaining straight portion of rod may be used.

1.29 WELDING

A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:

1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where

necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to their proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.29.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is open to view. The sample weld should be prepared using a 6-inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.

3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water (liquid lines only) at a sufficient flow rate and period of time, to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

B. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.

C. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.

D. Pressure Ratings: These tests shall not be used to establish pressure ratings.

E. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating. Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system

F. Test Temperature: Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature.

G. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

H. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.

I. Testing: Domestic hot and cold water piping and heating water piping shall be tested hydrostatically at the test pressures specified and shall show no drop in pressure in a 2-hour period. Leaks shall be located by soap testing

1. Test Pressures:
   a) Natural gas piping: as required by governing code
   b) Domestic Hot and Cold Water: 100 psig or 50% more than operating pressure, which ever is greater.

J. Sanitary Waste and Soil System:

1. After all soil and waste pipes and vent stacks have been installed, the outlets shall be plugged and the piping system filled with water in vertical sections to the highest point of the system and allowed to remain filled for twenty-four (24) hours and shall prove to be leaktight under such conditions. A one-inch drop will be allowed in water level in standpipe. This test may be conducted in segments as required by the sequence of construction. Contractor shall certify in writing that all tests were satisfactorily completed before piping was concealed, and shall submit the certification to the Architect/Engineer for their records and for transmittal to the Owner.

K. Test Report

1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay or absence of coordination.

1.32 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. They shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned and the entire system shall be delivered in a perfect, unblemished condition.

1.35 PAINTING AND IDENTIFICATION

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.

B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave their equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.

C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during the painting operation.

D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inches in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or their representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at any time requested by the Architect/Engineer (or their representative) during the construction or warranty periods.

END OF SECTION

SECTION 22 0523
VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. All valves except lubricated plug valves and butterfly valves shall be manufactured by Nibco, Hammond, Lunkenheimer, Kennedy, Stockham, Walworth, Powell, or Milwaukee.

B. Lubricated plug valves shall be as manufactured by Rockwell, Milwaukee, or Walworth.

C. Butterfly valves shall be as manufactured by W.C. Norris, Centerline, Nibco, Demco, Grinell, Milwaukee, or Keystone.

1.3 RELATED WORK IN OTHER SECTIONS

22 0000	PLUMBING INDEX
22 0500	GENERAL PLUMBING REQUIREMENTS
22 0700	PIPING INSULATION
22 1113	DOMESTIC WATER SYSTEMS
22 1313	SOIL AND WASTE PIPING SYSTEMS
23 0519	PIPING SPECIALTIES
23 0548	VIBRATION ISOLATION AND EXPANSION COMPENSATION

1.4 IDENTIFICATION OF VALVES

A. Each valve shall be provided with a stamped metal tag secured to the valve with metal chain. Tag shall indicate both the service and function of each valve. The Contractor shall furnish two prints of drawings showing floor plan for each floor with all valves accurately located and labeled. These drawings shall be neat and easily read.

PART 2 - PRODUCTS

2.1 VALVES

A. Domestic water: all domestic water system valves shall be lead free components.

1. Gate Valves 2" and Under: Nibco No. T134, rising stem, ductile iron hand wheel, union bonnet, solid wedge disc, bronze body, Class 150 psi working pressure.

2. Gate Valves 2-1/2" and Larger: Nibco No. F617-0, bronze trimmed, solid wedge disc, iron body, O.S. & Y., 125 psi working pressure.

3. Swing Check 2" and Under: Nibco No. T433, swing type, Y-pattern, all bronze, renewable seat & disc, regrinding, 200 psi working pressure.

4. Swing Check, 2-1/2" and Larger: Nibco No. F938-31, iron body, bolted bonnet, Class 150, bronze trimmed, check valves installed at discharge of pumps shall be non-slam type.

5. Globe Valves 2" and under: Nibco No. T235, union bonnet, integral seat, Class 150 bronze body with renewable disc.

6. Globe Valves, 2-1/2" and Larger: Nibco No. 718-B, bolted bonnet, cast iron body, 125 psi working pressure 0.S. & Y., pattern bronze trimmed.

7. Gate Valves 3” and Under for Copper Pipe: Nibco No. S134, union bonnet, Class 150 bronze rising stem wedge disc.

8. Globe Valves 2” Under for Copper Pipe: Nibco S-235, Class 150, bronze union bonnet, integral seat, renewable seat and disc.

9. Angle Valves 2” and Under Copper Pipe: Nibco T335, Class 150, Union Bonnet, integral seat, renewable seat & disc.

10. Angle Valves 2 1/2” and Larger: Nibco F8180-B, Class 125, bolted bonnet cast iron, renewable seat & disc., bronze trim.

11. Check Valve for 3” and under for Copper Pipe: Nibco S-433, Y-pattern, swing type, all bronze, renewable seat & disc.

12. Manual Balancing Valves:
    a) 2” and Under: Nibco T-585-70 ball valve or Milwaukee Butterball butterfly valve with calibrated flow set handle.
    b) 2-1/2” and Larger: W.C. Norris butterfly valves with lever with infinite throttling position as specified below.

13. Circuit Balancing Valves: Balance Valves shall be “Circuit Setter” balance valves as manufactured by Bell & Gossett.

14. Ball Valves:
    a) 1/2” to 2”: Nibco No. T-585-70, two piece body, bronze, screwed ends, Teflon seats, straight through flow design.

15. Lubricated Plug Valves: Rockwell Mfg. Co. “Permaturn” lubricated plug valves Fig. No. 143. Provide valve handle for each valve. Valves shall have tapered plugs with thermally bonded lubricated film.

16. Water Pressure Relief Valves for makeup to heating and cooling systems, and relief for heating and cooling system, Bell & Gossett No. 1170 unless otherwise noted.

17. Drain Valves: Nibco No. T134, 3” and smaller.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All valves shall be installed in locations which will allow easy operation and facilitate maintenance.

B. Gate and globe valves shall be installed with stems up.

END OF SECTION

SECTION 22 0700
PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and Install:

1. Piping insulation

2. Jackets and accessories

1.2 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Special Conditions and the General Requirements apply to the work specified in this section.

B. Insulation furnished under this specification shall comply with all requirements of the State Energy Code and the recommendations of the latest edition of ASHRAE 90.1 and these specifications. The more stringent of these shall be the standard for the work provided under these specifications.

C. The work included under this specification consists of furnishing all labor, accessories, equipment and materials necessary for installation of all piping, and mechanical equipment insulation systems. This includes but is not limited to:

1. Thermal Insulation
   a) Domestic hot water piping
   b) Refrigerant piping

2. Condensation Prevention Insulation
   a) Domestic cold water piping
   b) Roof drain and overflow piping and roof drains

1.3 RELATED WORK IN OTHER SECTIONS

22 0000	PLUMBING INDEX
22 0500	GENERAL PLUMBING REQUIREMENTS
23 0500	GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS

1.4 REFERENCES

A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

B. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded Hot Plate Apparatus.

C. ASTM C195 - Mineral Fiber Thermal Insulation Cement.

D. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.

E. ASTM C518 - Test Methods for Steady-State Heat Flux, Heat Flow Meter Apparatus.

F. ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

G. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

H. All preformed Fiberglass pipe insulation with factory applied jackets shall meet the following standards:

ASTM E84 – Surface Burning Characteristics of Building Materials

ASTM E96 – Jacket Permeance

ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation

ASTM C411 – Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

ASTM C547 – Mineral Fiber Preformed Pipe Insulation

ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

ASTM C795 – Thermal Insulation for use in Contact with Austenitic Stainless Steel

ASTM C1136 – Flexible Low Permeance Vapor Retarders for Thermal Insulation: Types I-IV.

NRC 1.36 – Nuclear Regulatory Commission Guide 1.36 Non-Metallic Thermal Insulation

NFPA 90A – Air Conditioning and Ventilating Systems

NFPA 255 – Test of Surface Burning Characteristics of Building Materials

UL 723 – Composite Surface Burning Characteristic

CAN/ULC S102-M – Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

MIL-I-22344D – Insulation, Pipe, Thermal, Fibrous Glass

MIL-I-24244C (Ships)

USCG 164.109 – Non-Combustible Materials

New York City MEA

GreenGuard Certified for Indoor Air Quality

GreenGuard Certified for Children and Schools

1.5 DEFINITIONS

A. Exposed Location: Exposed in mechanical rooms, rooms with finished walls or ceilings, and pipe chase between toilet rooms and equipment rooms.

B. Concealed Location: Located in furred spaces, attics, crawl spaces, above suspended ceilings in finished or unfinished rooms, or all other locations not exposed to view.

C. Cold Piping: Shall include domestic water and other piping with surface temperatures less than 70°F.

D. Hot Piping: Domestic hot water, supply and return and other piping with surface temperatures greater than 105°F.

E. Exterior Locations: All locations exposed, unexposed above grade or below grade beyond the building floor, wall or roof line of the structure or building

F. Location and Insulation Requirements:

1. Cold Water, including Non-potable Water (NPW): Insulate as follows:
   a) All piping above ceilings and in walls.
   b) Entire system except for stubouts to fixtures.

2. Domestic Hot: Insulate as follows:
   a) Entire system except for stubouts to fixtures.

3. Roof drains and over flows:
   a) All piping in building, ceilings, walls

4. K Factors: All K Factors shown in this Specification are expressed in BTU-in/hr.-ft^2-F.

1.6 SUBMITTALS

A. Comply with Section 220500.

B. Product Data: Provide product description, list of materials and thickness for each service and location.

C. Manufacturer's Installation Instructions: Indicate procedures, which ensures acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE

A. Qualifications of Applicator: Company specializing in piping insulation application with five (5) years minimum experience.

B. Regulatory Requirements Fire Hazard Classification: Insulation shall have a composite (insulation, jacket or facing, and adhesive to secure jacket or facing) fire hazard rating as tested by ASTM E-84, NFPA 255, and UL 723 not to exceed 25 flame spread, 50 fuel contribution, and 50 smoke developed. Materials shall be labeled accordingly.

1.8 DELIVERY, STORAGE AND HANDLING

A. Compliance: Comply with Section 230500. Deliver materials to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness and store in a warm, dry location.

1.9 PROJECT/SITE CONDITIONS

A. Storage Environment: Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation while in storage.

B. Environmental Requirements: Perform work at ambient and equipment temperatures as recommended by the insulation manufacturer.

C. Protection: Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Repair or replace any such insulation or covering damaged prior to final acceptance of work.

D. Application Surfaces: Surface shall be dry, free of dust, oil, construction residues or other foreign materials before insulation is applied. Piping joints shall be dry, leak free and tested before application of insulation occurs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Owens-Corning

2. Knauf

3. Johns Manville

4. Industrial Insulation Group

2.2 MATERIALS

A. Glass Fiber:

1. Insulation: ASTM C547; rigid molded, noncombustible.
   a) 'K' value: ASTM C335, 0.24 at 75 °F
      1) K values shall conform to the following at 75°F
         (a) Heating water to 250°F: .28
         (b) Heater water and Steam to 350°F or above: .32
         (c) Chilled water 40°F to 55°F: .24
         (d) Domestic water 105°F or greater: .24
   b) Minimum Service Temperature: -20°F
   c) Maximum Service Temperature: +450°F
   d) Maximum Moisture Absorption: 0.2 percent by volume

2. Vapor Barrier Jacket:
   a) All Service Vapor Retarder Jacket
   b) Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
   c) Secure with self-sealing longitudinal laps and butt strips.
   d) Alternate: Paper Free All Service Vapor Retarder Jacket

2.3 JACKETS

A. PVC Plastic

1. Jacket: ASTM C921, one piece molded type fitting covers and sheet material, off white color.
   a) Minimum Service Temperature: -40°F
   b) Maximum Service Temperature: +150°F
   c) Moisture Vapor Transmission: ASTM E96; 0.002 percent by volume
   d) Maximum Flame Spread: ASTM E84: 25.
   e) Maximum Smoke Developed: ASTM E84; 50
   f) Thickness: 20 mil.
   g) Connections: Brush on welding adhesive

2. Covering Adhesive Mastic: Compatible with insulation

3. Acceptable Manufacturers
   a) Proto
   b) Zeston
   c) Speedline

B. Canvas Jacket; UL listed.

1. Fabric: ASTM C921, 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.

2. Lagging Adhesive: Compatible with insulation.

3. Aluminum Jacket: ASTM B209.
   a) Thickness: 20 mil inch sheet.
   b) Finish: Smooth.
   c) Joining: Longitudinal slip joints with 2-inch laps.

d) Fittings: 0.016-inch-thick die shaped covers with factory attached protective liners.
e) Metal Jacket Bands: 3/8 inch wide; 0.015-inch-thick aluminum.

C. Aluminum Jacket: ASTM B209

1. Thickness: 0.016-inch sheet.

2. Finish: Smooth

3. Joining: Longitudinal slip joints and 2-inch laps.

4. Fittings: 0.016-inch-thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015-inch-thick aluminum.

D. Stainless Steel Jacket: Type 304 stainless steel.

1. Thickness: 0.016 inch

2. Finish: Smooth

3. Metal Jacket Bands: 3/8 inch wide; 0.016-inch-thick stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect work in conformance with Section 220500.

3.2 PREPARATION

A. Pipe Testing: Testing of piping shall be completed and leaks repaired prior to application of insulation. Surfaces shall be clean and dry before proceeding.

B. Installation: Install materials after piping has been tested and approved. See Section 220500.

C. Surface Cleaning: Clean surfaces for adhesives.

3.3 INSTALLATION

A. Pipe Insulation:

1. Manufacturer's Instructions: Install materials according to manufacturer's instructions.

2. Finished Surface Temperature: Insulation thickness shall conform to those recommended ASHRAE 90.1, latest edition, unless otherwise specified.

Thickness of insulation shall be sufficient to keep surface temperatures below 115°F.

3. Continuity: Apply insulation tightly over clean, dry surfaces with sections or edges firmly butted together. Make insulation continuous through sleeves or openings in walls and floors.

4. Make insulation continuous at pipe hangers, trapezes, and other types of supports. Do not notch insulation to fit over hangers, trapezes, and other supports. Install shields at all supports.

5. Name Plates: Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

6. Supports: Finish insulation neatly at hangers, supports and other protrusions. Locate insulation or cover seams in least visible locations.

7. Inserts: Provide an insert, not less than 6-inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2-inches diameter or larger, to prevent insulation from compressing at support points. Inserts shall be cork, hardwood or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used with field fabricated insulation value equal to insulation approved by the Project Engineer. Do not use calcium silicate inserts or other material that can absorb moisture on any below ambient piping system.

8. Enclosures: Do not insulate hot water heating pipe within radiation enclosures.

9. Flanges: On insulated piping without vapor barrier and piping conveying fluids 140°F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.

10. Equipment Fittings and Valve Coverings: Insulate all equipment, fittings and valves. Terminate insulation neatly with insulating and finishing cement troweled on bevel.

11. Preformed Fittings Locations: All fittings and valves shall be insulated with preformed fiberglass for fittings, mitered sections of pipe insulation or fiberglass blanket insulation of equal thickness to the adjacent pipe insulation. Cover the fittings, valves and insulation with preformed PVC jacket. Close jacket with stainless steel tacks and compatible adhesive.

12. Radiation Barrier: When insulating hot pipe fittings, a layer of kitchen-type aluminum foil shall be applied over the first fiber glass insert applied, making sure the aluminum foil is extended over the adjacent pipe insulation. A second fiber glass insert shall then be applied over the foil with a vapor seal at all the aluminum foil edges. Insulation thickness shall be such that the surface temperature shall not exceed 115°F.

13. Expansion Devices: On insulated piping with vapor barrier; insulate all equipment, fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

14. Fasteners: Avoid the use of staples on vapor barrier jackets. Seal vapor barrier penetrations with white vapor barrier finish and adhesive.

15. Adhesive Limitations: Apply adhesives to not exceed the coverage recommended by the manufacturer.

16. Wall, Floor and Ceiling Penetrations: Continue insulation with vapor barrier through penetrations including walls, floors and ceilings.

17. Enclosure: All insulation ends shall be firmly butted and secured with minimum 3-inch-wide butt strips. Exposed end of pipe insulation shall be sealed with vapor barrier mastic.

18. Repairs: Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

19. Service Access: When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.

20. A complete moisture and vapor seal shall be provided on cold surfaces where vapor barrier jackets or coatings are required. Anchors, hangers and other projections shall be insulated and vapor sealed to prevent condensation. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

21. Insulation shall be installed in a workmanlike manner by workmen regularly engaged in this type of work. Insulation shall not be applied until all surfaces are clean and dry and until inspection and release for insulation application.
    a) Do not notch insulation to fit around trapezes or wall-mounts fabricated from slotted metal framing (“unistrut or equal”), angle iron or other materials. Insulation shall be continuous across the support and an insulation shield shall be installed to prevent crushing the insulation. Pipe clamps shall be sized to fit around insulation and shield.
    b) Insulation may be notched or trimmed around riser clamps. Seal exposed insulation.

B. Jackets:

1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish fittings, joints, and valves

with premolded PVC jackets secured with stainless steel tacks. The precut insulation shall be held in place by copper wire or hemp twine, and be removable without damage to the insulation or jacket. Leave surfaces clean and ready for painting.

2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature shall have vapor barrier jackets, factory-applied or field-applied. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe, and finish with premolded PVC jackets.

3. Indoor, Exposed Applications: Mechanical Equipment Rooms, all insulated piping to be finished with aluminum jacket secured with metal jacket bands.

4. Indoor, Exposed Applications: Same as Indoor, Concealed Applications except that in addition the insulation shall be covered with an aluminum jacket secured with metal jacket bands.

5. Exterior Applications: Same as Indoor, Exposed Applications plus connect with a modified S lock equal to Premetco “Loc-Jack” Z-Crimp, Factory or Field installed. All seams shall be sealed with silicone caulking and have seams oriented so that the jacketing will shed water & not tend to trap and enter rain water.

3.4 APPLICATION

A. Fittings and Valves Insulation:

1. Premolded Fittings: All insulated pipe fittings shall be insulated with 20 mil PVC Zeston one piece premolded insulated fittings wherever possible. If Zeston fittings are not available for the use required, comply with the following paragraph #2. Insulate fittings with fiberglass tightly wrapped with copper wire or heavy hemp twine to within 1/4 inch of thickness of adjoining copper wire or insulation, finished with 1/4 inch of insulating cement troweled flush with pipe insulation. A tack coat of mastic vapor barrier Foster 60-25 or 26-to-1/16-inch thickness or equal shall be applied to fittings and valves. Apply 6 oz. fiberglass canvas jacket to build-up (not PVC) fitting band valve insulation. Cement laps thoroughly with Foster 81-42 or 30-36 adhesive.

B. Perm Rating Vapor Barrier Mastic Coatings:

1. Perm rating not more than 0.25 when tested in accordance with ASTM E96, Procedure A Fire Retardant.

C. Adhesives, Sealers, Facings, and Vapor Barrier Coatings:

1. Compatible with materials to which applied, and shall not corrode, soften, or otherwise attach the pipe or insulation materials in either the wet or dry

state. Use only adhesives, sealers, facings, and vapor barrier coatings recommended by the approved manufacturers of insulation materials.

3.5 SCHEDULE

Service	Pipe Size	Thickness
CW, HW, HWC	All sizes CW, 1/2 inch to 1 1/4 inch HW, HWC	1 inch
	1-1/2 inch and Larger HW, HWC	1-1/2 inch
NPW & Cooling Condensate	All sizes	1 inch

END OF SECTION

SECTION 22 1000
PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 SCOPE

A. This section of the specifications encompasses the basic materials and methods of the various piping systems covered in Division 25.

B. Standards: The latest edition of each standard referenced shall be used to determine compliance.

1.3 RELATED WORK IN OTHER SECTIONS

22 0000	PLUMBING INDEX
22 0500	GENERAL PLUMBING REQUIREMENTS
22 0523	VALVES
22 0700	PIPING INSULATION
22 1113	DOMESTIC WATER SYSTEMS
22 1313	SOIL AND WASTE PIPING SYSTEMS
23 0519	PIPING SPECIALTIES
23 0548	VIBRATION ISOLATION AND EXPANSION COMPENSATION

1.4 IDENTIFICATION OF PIPING

A. All accessible piping shall be labeled at not more than 10 ft. intervals with labels indicating the service and direction of flow. Pipe labels shall be self-adhesive labels, all-temperature Perma-Code pipe markers No. B-500, manufactured by the W.H. Brady Company. The background color code for all markers shall conform to the American National Standard A13.1 - 1975 "Scheme for the Identification of Piping Systems."

B. The color red shall be for the exclusive use on fire protection service piping and sprinkler piping per OSHA regulations (CFR 1910.144).

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

A. Exterior Water Distribution

1. Copper: Type K hard, seamless copper tube conforming to ASTM B88 with silver brazed joint per ASTM B260 Class BAg-1 with wrought copper fittings per ANSI B16-22.

2. Cast Iron: Cement lined cast iron pipe, 3" and larger, 18-40 or 21-45, Class 250 complying ASA A-21.1 or equivalent ductile iron pipe with resilient joints in straight runs per ANSI A21.11 and mechanical joints with set screw retaining glands and engineered thrust blocks at turns, offsets, fittings and valves.

3. Ductile Iron: ANSI A21.51, minimum working pressure 200 psi. Cement mortar lined per ANSI A21.4. Mechanical joint fitting per AWWA C110 or push-on fittings per AWWA C110 and ANSI A21.11. Fittings shall be cement lined per ANSI 21.4, standard thickness.

B. Domestic water system

1. Above grade:
   a) Copper: Shall be Type K soft drawn, or Type L hard drawn, seamless copper tubing conforming to ASTM B88, with wrought copper and bronze solder joint pressure fittings conforming to ANSI B16.22.

2. Underground:
   a) Copper: Type K hard, seamless copper tubing conforming to ASTM B88 with silver brazed joints (ASTM B260 Class BAg-1) with wrought copper fittings per ANSI B16.22.

C. Soil and waste system

1. Above ground:
   a) Cast Iron: Shall be cast iron hub and spigot soil pipe or hubless cast iron pipe and fittings, (No-Hub Couplings shall conform to CISPI Standard 310 & ASTM A1277 or latest edition) conforming to ASTM A74 (latest edition) and/or Cast Iron Soil Pipe Institute (CISPI) CS-888 and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. The hub and spigot pipe shall use compression gasket joints per ASTM C564 & ASTM 1563.

2. Underground inside building:
   a) Cast Iron: Shall be cast iron hub and spigot soil pipe or hubless cast iron pipe and fittings, (No-Hub Couplings shall conform to CISPI Standard 310 & ASTM A1277 or latest edition) conforming to ASTM A74 (latest edition) and/or Cast Iron Soil Pipe Institute (CISPI) CS888 and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. The hub and spigot pipe shall use compression gasket joints per ASTM C564 & ASTM 1563.

D. Sanitary vent system

1. Vent piping 2" and smaller in diameter may be schedule 40 galvanized steel pipe conforming to ASTM A53 with 150-pound galvanized malleable iron screwed fittings conforming with ANSI B16.3. Vent piping larger than 2" shall be cast iron as specified for interior soil and waste.

E. Natural gas piping system

1. Black steel: Above grade piping shall be Schedule 40, black steel pipe conforming to ASTM A53, with 150-pound malleable iron screwed fittings conforming with ANSI B16.3. or seamless carbon steel weld fittings conform to ASTM A234.

2. Underground piping shall be schedule 40 black steel pipe conforming to ASTM A53 machine wrapped with Scotchwrap PVC tape using 50% overlap. Fittings and joints shall be double wrapped to a minimum 6 inches beyond the fitting. Pipe shall be primed prior to wrapping per manufacturer's recommendations.

2.2 JOINTS

A. Copper:

1. Silver brazed joints shall use brazing material containing approximately 45% silver, 15% zinc, 25% cadmium and 15% copper. Joints shall conform to ASTM B-260 Class BAg-1. Approved materials include Mueller #122, Lucas Milhaupt "Easy Flo45" and United Wire and Supply "Sil-Bond 45".

B. Cast Iron:

1. Neoprene Rubber gaskets for hub and spigot piping per ASTM C564.

2. No hub joints shall consist of couplings that conform to CISPI 301.

C. Ductile Iron: Joints shall be of the stuffing box type per ANSI 21.11 as modified by ANSI 21.51 or push-on type per ANSI 21.51. Rubber gaskets and lubricant shall be per ANSI 21.11.

D. Black Steel:

1. Screwed joints shall be made with no more than three threads showing using teflon tape or teflon joint sealing compound.

2. Welded joints shall be fusion welded to full metal depth with width at least 2 1/2 times the depth of the metal being joined.

E. Bell and spigot joints shall conform to AWWA C200 with rubber gaskets.

F. Bonded joints shall have metallic bond including joints made with flexible couplings, caulking or rubber gaskets. Metallic bond shall be of ferrous material to effect continuous conductivity. Bond wire shall be type RHW-USE, size 1/0 neoprene gasketed copper conductor. Bond shall be thermal weld type.

G. Insulating joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe. Insulating joints shall consist of a sandwich type flange insulating gasket of the dielectric type, insulating washers and insulating sleeves for flange

bolts. Gaskets shall be full faced. Bolt insulating sleeves shall be full length. Units shall be of a construction to prevent metal to metal contact of dissimilar piping materials.

2.3 FLOOR, WALL AND CEILING PLATES

A. Where exposed pipes pass through finished floors, finished walls or finished ceilings, they shall be fitted with chromium plated spun brass flanges or flanges to match the type of pipe or pipe finish used. Plates shall be large enough to completely close the hole around the pipe and shall be not less than 1-1/2" or more than 2-1/2" larger than the diameter of the pipes. All plates shall be securely held in place.

2.4 UNIONS

A. Piping 2-1/2" and larger to have bolted flange unions with gaskets of material suitable for the specified service. Ground joint unions with brass to iron seats shall be used in piping 2" and smaller. Unions shall be installed at all valves and equipment connections.

B. Insulating Unions: See Specification Section 230519.

2.5 HANGERS AND ANCHORS

A. To prevent galvanic action between copper pipe and a dissimilar metal, copper pipe shall be isolated to prevent the pipe from contacting the dissimilar metal. This may be accomplished by mounting the pipe in an isolation fitting, or by wrapping the pipe with a 20-mil thickness of UPC-rated isolation tape. The 20-mil thickness can be accomplished by using a single wrap of 20-mil tape or by using 10-mil tape with a 50% overlap.

B. Copper pipe does not need to be isolated from copper plated pipe hangers that are suspended from hanger rods.

C. Copper pipe mounted on slotted metal framing (“unistrut or equal”), angle iron, or other dissimilar metal support shall be isolated as described above, even if pipe clamps used are copper plated. Painted, epoxy or powder-coated finishes on the metal support are not an acceptable means of isolation.

D. All piping shall be rigidly supported from the building structure by means of adjustable ring type hangers. Where pipes run side by side, support on rod and angle trapeze hangers. Hangers shall be spaced not greater than 5 feet on centers for cast iron piping, 6 feet on centers for copper piping and 10 feet on centers for steel piping. Plastic pipe shall be supported on not more than 3 feet centers. Round rods supporting the pipe hangers shall be of the following dimensions:

1.	1/2 inch to 2 inch pipe	3/8 inch rod
2.	2-1/2" inch to 3 inch pipe	1/2 inch rod
3.	4 inch to 5 inch pipe	5/8 inch rod

E. Rods for trapeze hangers shall be a minimum of 3/4 inch and shall have the equivalent cross section listed above per pipe supported. The use of pipe hoods, chains, or perforated iron for pipe supports will not be permitted. Insulated piping shall have hangers outside of insulation with 18 ga. protection sleeves 12" long. Anchors and guides shall be as detailed on the drawings. The Contractor shall provide inserts in the building construction at the time the concrete is poured, and the hangers shall be attached to these inserts. Where inserts cannot be used expansion shields may be used provided the hanger is not attached rigidly to the bolt but is supported from an angle held in place by the expansion bolt. The use of expansion shields must be approved by the Architect/Engineer. See drawings and details for support of tunnel piping.

F. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide and erect in a workmanlike manner according to the best practices of the trade all piping shown on drawings and required for the complete installation of the systems. The piping shown on the drawings shall be considered as diagrammatic for clarity in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be offset, lowered or raised as required or as directed at the site. This does not relieve the Contractor from responsibility for the proper erection of systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect/Engineer.

B. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing or forcing, properly clearing equipment and all windows, door, and other openings. Cutting or other weakening of the building structure to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods. All changes in direction shall be made with fittings.

C. All open ends of pipes and equipment shall be properly capped or plugged with plugs manufactured for this purpose to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton waste or similar materials may not be used in plugging.

D. All piping shall be arranged avoiding interference with removal and maintenance of equipment, filters or devices; and not blocking access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided at the piping connections to all items of equipment.

E. Valves and specialties shall be placed to permit easy operation and access, and valves shall be regulated, packed and adjusted at the completion of the work before final acceptance.

F. All piping shall be erected to ensure proper draining. Domestic water piping may be run level but shall be free from traps.

G. Soil and waste piping and other gravity drains shall be sloped down in direction of flow minimum one inch in 20 feet.

3.2 ACCESS DOORS

A. Furnish all access doors required for access to valves, controls, or other items for which access is required for either operation or servicing. All costs incurred through failure to perform this function as the proper sequence of the work dictates shall be borne by this Mechanical Contractor.

B. The type of access door shall be as required by the room finish schedule. Acoustical tile access doors shall be equal to Krueger Style B, Style A for acoustical plaster, or Style C-CF for sidewall drywall or plaster construction.

3.3 JOINTS

A. Resilient molded gaskets shall be used on hub and spigot piping. For cast iron soil pipe not located under buildings, the Contractor may also use the No-hub sanitary system for pipe 6" and below with neoprene sealing gaskets, stainless steel retaining sleeves and two draw bands. An adequate torque wrench shall be used for system installation in accordance with manufacturer's recommendations.

B. Screwed Joints: Screwed joints shall be American Standard taper pipe threads. Ream pipe ends and remove burrs after threading. Make up joints using an approved compound or teflon tape, applied to the male threads only.

C. Brazed and Soldered Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections.

D. Welded Joints: On black steel piping 2 inches and above in size, the joints shall be welded. Welding shall be done using either gas or electric welding equipment. Certified welders shall be used. All pipe surfaces shall be thoroughly cleaned before welding. Each joint shall be beveled before being welded. Piping shall be securely aligned and spaced and the width of circumferential welds shall form a gradual increase in thickness from the outside surface to the center of the weld. The Contractor shall use appropriate materials to protect the structure and provide adequate fire protection at all locations where welding is done. All elbows shall be long radius unless otherwise specified. Wherever tee connections are made to piping systems on the main run, welding sockets may be installed for the branch connections up to one half the size of the main run. On connections larger than one half the size of the main run, welding tees shall be used. The use of fittings formed from welded pipe sections will not be permitted.

E. Flanged Joints:

1. Cast iron flanges shall conform to the American Standard for cast iron pipe flanged fittings, Class 125 (B.16.1). Gaskets shall be suitable for the service on which used.

2. Steel flanges shall be 150 lb. raised face type.

3.4 PUMP AND EQUIPMENT CONNECTIONS

A. All piping connecting to pumps or other equipment shall be installed with isolation valves and flexible connections to prevent strain at the connection to equipment. The Contractor shall be required as directed to disconnect piping to demonstrate that piping has been so connected. Provide a suction diffuser at each end suction pump where the inlet piping has a straight run of less than 15 pipe diameters in length. Suction diffusers shall consist of angle type body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16 inch diameter openings for pump protection. Strainer free area shall be five times the section area of the pump connection. Provide an adjustable support foot for diffusers installed on end suction pumps.

3.5 PIPE SLEEVES

A. Pipe sleeves shall be furnished and set by the Contractor, and the Contractor shall be responsible for their proper and permanent location. Piping will not be permitted to pass through footings, beams or ribs unless so noted on the drawings or with the consent of the Architect/Engineer. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through concrete or masonry construction and through all exterior walls, regardless of construction. Pipe sleeves, except sleeves in footings and beams shall be of sufficient diameter to provide approximately 1/4-inch clearance around the pipe, and in cases of insulated pipes, approximately 1/4-inch around the insulation. Pipe sleeves in footings and beams and exterior walls shall be of steel pipe. Sleeves in footings shall be not less than one inch or more than two inches larger in diameter than the pipe to be installed. Pipe sleeves in floors shall be cut flush with finished floor. Openings between piping and sleeves shall be made watertight with plastic cement to a minimum depth of two inches. Openings between piping and sleeves in all masonry or concrete interior walls and partitions shall be similarly caulked for acoustical reasons.

3.6 EXPANSION AND CONTRACTION

A. The Contractor shall make all necessary provisions for expansion and contraction of piping with offsets or loops and anchors to prevent undue strain.

3.7 PROTECTIVE COATINGS

A. All underground pipe except exterior cast iron water distribution pipe shall be wrapped with "Scotchwrap" No. 50 tape to give not less than two complete layers on the entire underground piping system, or piping shall have X-TRU Coat factory applied plastic protective covering.

B. All buried exterior cast iron water distribution piping shall be tar coated.

3.8 TESTING

A. Before any insulation is installed or before piping is covered or enclosed all piping systems shall be tested and proved tight at not less than 1 1/2 times the maximum service pressure which the piping systems will be required to handle, unless otherwise specified.

B. All tests shall be conducted in the presence of the Architect/Engineer and the building Owner or his representative. Any systems failing to meet the specified test requirements shall be corrected and retested until the test requirements are met.

3.9 FLUSHING, DRAINING AND CLEANING PIPE SYSTEMS

A. The Contractor shall flush water piping systems with water before placing them in operation. After systems are in operation and during the test period all strainer screens shall be removed and thoroughly cleaned. The Contractor shall notify the Architect/Engineer in writing when this requirement is to be accomplished.

B. All domestic water lines shall be sterilized as described in Section 221113 - DOMESTIC WATER SYSTEM of these specifications.

END OF SECTION

SECTION 22 1113
DOMESTIC WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish and install the Domestic Water System as shown on the drawings including specialties shown or called out in the fixture and/or equipment list and as necessary for satisfactory operation of the system.

1.3 RELATED WORK IN OTHER SECTIONS

22 0000	PLUMBING INDEX
22 0500	GENERAL PLUMBING REQUIREMENTS
22 0523	VALVES
22 0700	PIPING INSULATION
22 1000	PIPE AND PIPE FITTINGS
23 0519	PIPING SPECIALTIES

1.4 STERILIZATION

A. All domestic water piping shall be sterilized as described in Part 3 of this section.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Pipe and pipefittings shall be as described in Section 22 1000 - PIPE AND PIPE FITTINGS.

B. All piping in any utilities tunnel shall have welded or silver brazed joints.

2.2 SHOCK ABSORBERS

A. Shock absorbers and/or air cushions shall be installed where shown on the drawings. Shock absorbers shall be equal to Zurn Z-1700, Diatrol Series 500 or approved equal sized for the system being protected.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation shall conform to the requirements of Section 22 0500 - GENERAL PLUMBING REQUIREMENTS, and Section 22 1000 - PIPE AND PIPE FITTINGS.

B. Insulating couplings shall be furnished and installed at all connections between copper and steel pipe to prevent electrolysis.

C. Each water service main, branch main, riser and branch to a group of fixtures shall be valved. Stop valves shall be provided at each fixture.

3.2 STERILIZATION

A. Domestic Water lines shall be sterilized as follows: Chlorine shall be applied to provide a solution of not less than 250 PPM. The chlorinating material shall be introduced into the waterline in a manner approved by the Architect/Engineer. The solution shall be circulated if provided with pumps and all valves in the line shall be operated several times during the contact period. After a contact period of no less than eight (8) hours the system shall be flushed with clean water until the residual chlorine content is not greater than 0.2 PPM.

B. The sterilization procedure shall be witnessed by the Architect/Engineer and Owner.

3.3 TESTS

A. General: All tests shall be conducted in the presence of the Architect/Engineer or his representative. Any systems failing to meet the specified test requirements shall be corrected and retested until the test requirements are met.

B. Water Systems: The complete water systems shall be hydrostatically tested at a pressure of 150 psi and shall show no loss in pressure for a period of one hour.

END OF SECTION

SECTION 22 1313
SOIL AND WASTE PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish and install the soil and waste piping system as shown on the drawings including specialties shown or called out in the equipment list and as necessary for satisfactory operation of the system.

1.3 RELATED WORK IN OTHER SECTIONS

22 0000 PLUMBING INDEX
22 0500 GENERAL PLUMBING REQUIREMENTS
22 1000 PIPE AND PIPE FITTINGS

1.4 REQUIREMENTS

A. See Sections 22 0500 - GENERAL PLUMBING REQUIREMENTS and 22 1000 - PIPE AND PIPE FITTINGS for general requirements.

B. Furnish and install all concrete, grout and other required materials to fill all block outs and/or sleeves left open for this Subcontractor's convenience or for the installation of this work.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. The pipe and pipefittings shall be as described in Section 22 1000 - PIPE AND PIPE FITTINGS.

2.2 FLOOR DRAINS

A. Drains shall be Zurn, Wade, or Smith and shall be equal to those specified on the drawings.

2.3 FLOOR SINKS

A. Drains shall be Zurn, Wade, or Smith and shall be equal to those specified on the drawings.

2.4 CLEANOUTS

A. Cleanouts shall be as manufactured by Zurn, Wade, or Smith and shall be of the same size as the pipe except that cleanout plugs larger than four inches will not

be required. Cleanouts installed in connection with cast iron soil pipe shall consist of a long sweep, quarterbend or one or two eighth bends extended to an easily accessible place, or as indicated on the drawings.

B. Cleanouts in finish floors shall be of the type made to match the floor and/or covering. All exposed metal shall be polished or chrome plated brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall conform to Section 22 0500 - GENERAL PLUMBING REQUIREMENTS, and Section 22 1000 - PIPE AND PIPE FITTINGS.

B. Flashings: Vent pipes shall be flashed and made watertight at the roof with sheet lead flashing. Flashing shall weigh at least four pounds per square foot, shall be 24 inches square and shall be turned up around the pipe and into the top of the pipe. Vent pipes shall extend at least 12 inches above roof.

C. Traps: Each fixture and piece of equipment connecting to the drainage system shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double trapped.

D. Floor Drains: All floor drains shall be installed with grates square with the building lines.

3.2 TESTS

A. The entire sanitary system shall be tested in accordance with the requirements of the State Plumbing Code, all local codes and ordinances, and the Uniform Plumbing Code.

END OF SECTION

SECTION 22 4200
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SCOPE

A. Plumbing fixtures shall be supplied, set and connected as shown on plans. Fixtures shall be protected from damage during construction and shall be thoroughly cleaned of all tape, paint and adhesive prior to final acceptance.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Plumbing fixtures shall be as manufactured by KOHLER, AMERICAN STANDARD, or SLOAN and shall be as scheduled on the drawings.

B. Flush valves shall be as manufactured by Zurn, Delany, or Sloan.

2.2 FITTINGS AND PIPES

A. Fittings and piping shall be brass and whenever exposed, shall be polished chrome-plated. Provide tight fitting wall and/or floor escutcheons of chrome-plated brass whenever pipes pass through floors, wall or ceilings.

B. All porcelain or vitreous china shall be clean, smooth and bright. All shall be warranted not to craze, discolor or scale.

C. This contractor shall furnish and install all required water, waste, soil and vent connections to all plumbing fixtures together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.

D. All automatic or self-closing valves for faucets shall be adjusted in accordance with manufacturer's instructions and supervised as necessary by equipment supplier's representative at the request of the Architect or Engineer.

E. Owner furnished equipment shall be connected with drains, traps, hot water, cold water and other services required for optimum operation. This contractor shall obtain information from the Owner or his approved representative for services required or field verify specific requirements.

END OF SECTION

SECTION 23 0000
HEATING, VENTILATING, AND AIR CONDITIONING INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Heating, Ventilating, And Air Conditioning Work, as indicated on the Drawings and specified herein. Heating, Ventilating, And Air Conditioning work indicated on the Drawings and/or specifications covering other trades shall conform to Division 23 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Heating, Ventilating, And Air Conditioning systems, shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for Heating, Ventilating, and Air Conditioning service connections to all the various items of equipment requiring connection throughout the project shown on the Contract Drawings (even if not shown on Heating, Ventilating, and Air Conditioning Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 HEATING, VENTILATING, AND AIR CONDITIONING DIVISION INDEX

230100	DEMONSTRATION AND TRAINING
230500	GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS
230519	PIPING SPECIALTIES
230548	VIBRATION ISOLATION AND EXPANSION COMPENSATION
230593	BALANCING OF MECHANICAL SYSTEMS
231126	LIQUID PETROLEUM GAS SYSTEM
233000	AIR DISTRIBUTION
233113	DUCTWORK CLEANING

PART 2 – PRODUCTS (Not used.)

PART 3 – EXECUTION (Not used.)

END OF SECTION

SECTION 23 0100
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. After completion of the installation and upon completion of the Test and Balancing, the Contractor shall schedule the System Demonstration, Operating Test, and Training Session for the Owner.

B. The following individuals, companies or representatives thereof shall be in attendance.

1. Mechanical Trade
2. Electrical Trade
3. Sheet Metal Trade
4. Controls Trade
5. Test and Balance Agency

1.3 RELATED WORK IN OTHER SECTIONS

23 0000	HEATING, VENTILATING AND AIR CONDITIONING INDEX
23 0500	GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS
23 0548	BALANCING MECHANICAL SYSTEMS

1.4 QUALIFICATIONS

A. The representatives listed in 1.2B above shall be thoroughly familiar with the operation and function of the equipment or systems he represents and be prepared to indoctrinate the Owner or his designated personnel.

PART 2 - PRODUCTS

2.1 SCHEDULE

A. The Contractor shall schedule and coordinate the System Demonstration and Training Session for the Owner over 1 consecutive 8 hour working day.

B. The Owner may, after the training session has started:

1. Excuse the equipment manufacturer when his indoctrination session is completed.

2. Conclude the session early if he feels the intent and purpose of the session has been met.

2.2 ADJUSTMENTS

A. The Contractor shall have available, tools, equipment and personnel to readjust or refine the operation of any part of the mechanical system as directed by the Owner or Architect/Engineer.

PART 3 – EXECUTION

3.1 TRAINING

A. The Contractor shall schedule and coordinate the indoctrination of the Owner and his designated personnel during the Operating Test. The proposed time schedule shall be coordinated with the individuals, companies or representatives who will be conducting the indoctrination and training. This proposed time schedule shall be submitted to the Architect/Engineer for approval.

B. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and system at agreed upon times.

C. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months.

1. Contractor shall provide a minimum of eight (8) hours of training for seasonal system operation.

2. Contractor shall prepare a written report of training and submit to architect upon completion of training.

D. Use operation and maintenance manuals as a basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

E. Prepare and insert additional data in Operation and Maintenance manual when need for such data become apparent during instruction.

3.2 DOCUMENTATION

A. The Contractor shall prepare an indoctrination schedule similar to the following:

INDOCTRINATION SCHEDULE:
PROJECT:
LOCATION:

PERSONNEL	ITEM/SYSTEM	DATE	START TIME	STOP TIME

B. The Owner shall initial each line to verify attendance.

3.3 OPERATING INSTRUCTIONS

A. The operating instructions specified in Sections 23 0500 and 25 3000 of these specifications shall be presented at the start of the Session. These instructions shall include manufacturer's published data having all information that does not apply crossed out.

3.4 OPERATING TEST

A. The Contractor shall conduct an operational test on all equipment installed under this Division of the Specifications. This test shall be continuous for a minimum of three consecutive days within seven days prior to the demonstration and training period with required data available at the demonstration and shall continue during the demonstration period. The test shall verify the operation of the mechanical systems and demonstrate the performance of the total system.

B. The following data shall be recorded hourly during normal building occupancy hours.

1. Outdoor ambient temperatures:
   a) Measure and record outdoor dry bulb and wet bulb temperature.
   b) Calculate and record relative humidity.

2. Indoor space temperature:
   a) Measure dry bulb temperature in several rooms served by each air handling unit including at least one room in each control zone. Note any variation over 2`F from setpoint.
   b) Measure wet bulb temperature in each space having a space humidistat. Calculate space relative humidity and note any variation over 5% from setpoint.

3. Air Temperatures:
   a) Entering and leaving each piece of equipment having air temperature change including:
      1) DX refrigeration coils
      2) Chilled water coils
      3) Air Handling Unit return, OSA and mixed air
      4) Fan coils
      5) Unit Heater

4. Air Pressure:
   a) Building static pressure relative to ambient (outside)
   b) Supply static pressure at outlet of each air handling unit
   c) Supply static pressure at the end of each duct run
   d) Supply static pressure at the inlet of each variable air volume terminal

5. Weather Conditions:
   a) Sun
   b) Wind velocity
   c) Precipitation
   d) Barometric pressure

3.5 READINGS AND MEASUREMENTS

A. The Test and Balance Agency shall be available and take any or all readings and measurements required or desired by the Owner or Architect/Engineer during this Demonstration and Training Session.

END OF SECTION

SECTION 23 0500
GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: General Mechanical Requirements specifically applicable to Division 23 sections in addition to Division 1 - General Requirements.

B. Scope:

1. The work covered by this division consists of performing all operations in connection with the installation of heating, cooling, ventilating, and plumbing including site utility work as indicated under this section. This entire section applies to all mechanical work and all mechanical sections of these specifications. This Contractor shall read and comply with all sections of these specifications including all General and Special Conditions.

1.2 REFERENCES

A. Standard Requirements:

1. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. All work shall be executed in accordance with the local and state codes, ordinances, and regulations governing the particular class of work involved. This Contractor shall be responsible for the final execution of the work under this heading to suit these requirements. In the event of a conflict between the various codes and standards, the more stringent shall govern. Where these specifications and accompanying drawings conflict with these requirements, the Contractor shall report the matter to the Architect/Engineer. The Architect/Engineer shall prepare any supplementary drawings required, illustrating how the work may be installed so as to comply. On approval of the change by the Architect/Engineer, the Contractor shall install the work in a satisfactory manner without additional cost to the Owner. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved, and on completion of the work, this Contractor shall obtain and deliver to the Owner final certificates of acceptance. This Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. The Contractor shall secure all permits and licenses for their work and shall pay all fees in connection with such permits and licenses.

D. The contractor shall hold and save the Owner free and harmless from liability of any nature or kind arising from their failure to comply with codes and ordinances.

E. Any and all meter deposits and all utility extension costs shall be paid by the Contractor whose work is done in connection with the service that the meter is connected to.

F. Schedule of Referenced Organizations: The following is a list of the acronyms of organizations referenced in these Specifications:

1. AABC Associated Air Balance Council

2. ADC Air Diffusion Council
435 North Michigan Ave.
Chicago, IL 60611

3. AGA American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209

4. AMCA Air Movement and Control Association
30 West University Drive
Arlington Heights, IL 60004

5. ANSI American National Standards Institute
1430 Broadway
New York, NY 10018

6. ASHRAE American Society of Heating Refrigerating and Air Conditioning Engineers
345 East 47th Street
New York, NY 10017

7. ASME American Society of Mechanical Engineers
345 East 45th Street
New York, NY 10017

8. ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

9. AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

10. AWS American Welding Society
2501 NW 7th Street
Miami, FL 33125

11. FM Factory Mutual System
1151 Boston-Providence Turnpike
Norwood, MA 02062

12.	FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Building 197 Washington, DC 20407
13.	NBFU	National Board of Fire Underwriters 5530 Wisconsin Avenue, Suite 750 Chevy Chase, MD 20815
14.	NEC	National Electric Code (of NFPA)
15.	NEBB	National Environmental Balancing Bureau 8224 Old Courthouse Road Vienna, VA 22180
16.	NEMA	National Electrical Manufacturer's Association 2101 L Street, NW Washington, DC 20037
17.	NFPA	National Fire Protection Association Battery March Park Quincy, MA 02269
18.	NSF	National Sanitation Foundation Box 1468 Ann Arbor, MI 48106
19.	OSHA	Occupational Safety and Health Administration U.S. Department of Labor
20.	SMACNA	Sheet Metal and Air Conditioning Contractor's National Association 8224 Old Courthouse Road Vienna, VA 22180
21.	TIMA	Thermal Insulation Manufacturers Association Technical Services 1420 King Street Alexandria, VA 22314
22.	UL	Underwriters Laboratories, Inc. 333 Pfingston Road Northbrook, IL 60062

G. Underwriters Laboratories Inc. (UL): All materials, appliances, equipment, devices or appurtenances shall conform to the applicable standards of Underwriters Laboratories Inc., where such standards have been established.

1.3 DRAWINGS

A. Drawings and specifications shall be considered as cooperative, and work or materials called for by one and not mentioned in the other, or vice versa, shall be done and furnished as though treated by both.

B. In the cases of discrepancies in figures, drawings, or specifications, the Architect/Engineer shall be notified immediately, and their decision shall determine the necessary adjustment. Without such decision, said discrepancies shall not be adjusted by the Contractor save only at their expense, and, in case of any settlement or any complication arising from such adjustment to the Contractor, they shall bear all extra expense involved.

C. Should it appear that the work intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained on the drawings or specifications, the Contractor shall apply to the Architect/Engineer for such further drawings or explanations as may be necessary, allowing a reasonable time for the Architect/Engineer to supply same, and the Contractor shall conform to same as part of the Contract.

D. Should any doubt or question arise in respect to the true meaning of the drawings or specifications, reference shall be made to the Architect\Engineer whose decision shall be final and conclusive. No alleged oral admission, condonation, or inadvertent neglect on the part of the Architect/Engineer will be accepted as an excuse for inferior work.

E. The mechanical plans do not give exact details as to elevations of ductwork and piping, exact locations, etc., and do not show all offsets, control lines, pilot lines, and other installation details. The Contractor shall carefully lay out their work at the site to conform to the structural conditions, provide proper grading of lines, to avoid all obstructions, to conform to details of installation supplied by the manufacturer of the equipment to be installed, and thereby to provide an integrated, satisfactory operational installation.

F. Should the particular equipment which any Bidder proposes to install require other space conditions than those indicated on the drawings, the Bidder shall arrange for such space with the Architect/Engineer before submitting their bid. Should changes become necessary on account of failure to comply with these details, the Contractor shall make such necessary changes at their (the Contractor's) own expense.

G. The Contractor shall submit working scale drawings of all their apparatus and equipment which in any way varies from these specifications and plans which shall be checked by the Architect/Engineer and approved before the work is started, Contractor before work proceeds. Interference with structural conditions shall be corrected by the Contractor.

H. All equipment shall be installed in accordance with the manufacturer's recommendations. Provide all accessories and components for optimum operation as recommended by the manufacturer.

I. Site visit: The Contractor shall visit the site prior to bidding and satisfy themself as the conditions under which the mechanical systems are to be installed. No subsequent allowance shall be made on their behalf for failure to make such a visit. Contractor shall examine all work noted under the demolition drawings and all new work and shall satisfy themself as to the extent of work required to be completed.

1.4 SYSTEM DESCRIPTIONS

A. Not Used.

1.5 PRIOR APPROVALS

A. Each equipment item for which the Contractor desires to install equipment other than the specific item identified in the equipment schedule or equivalent equipment by manufacturers specifically named in the schedule, the Contractor shall bear full responsibility to prove to the Engineer that the furnished equipment is equivalent to or better than the specified item. Failure to provide such proof will result in rejection of the shop drawing submittal by the Engineer. Prior written or verbal approval by the Engineer of equipment by other manufacturers will not relieve the Contractor of responsibility to provide equivalence. Prior approval is required, however, any prior approval given is intended only to provide preliminary agreement that the alternate manufacturer may make equipment that complies with the specification requirements and not that all equipment manufactured by them is acceptable.

1.6 SHOP DRAWINGS

A. Shop drawings or fully descriptive catalog data shall be submitted by the Contractor for all items of material and equipment furnished and installed under this Contract. This shall include piping, ductwork, mechanical equipment, plumbing equipment, control items, etc. The Contractor shall submit to the Architect/Engineer a sufficient number of copies of all such shop drawings or catalog data to provide them with as many review copies as they may need, plus three (3) copies for retention by the Architect/Engineer. No materials or equipment shall be installed until officially approved by the Architect/Engineer.

B. Before submitting Shop Drawings to the Architect/Engineer for review, the Contractor shall examine them and satisfy themself that they are correctly representative of the material or equipment to which they pertain. The Contractor shall so note these Drawings before submitting them. The Contractor's review of Shop Drawings is not intended to take the place in any way of the official review of the Architect/Engineer, and the Shop Drawings which have not been reviewed by the Architect/Engineer shall not be used in fabrication or installing any work.

C. The review of Shop Drawings or catalog data by the Architect/Engineer shall not relieve the Contractor from responsibility for deviations from the plans and Specifications unless they have, in writing, specifically called attention to such deviations as the time of submission and has obtained the permission of the Architect/Engineer thereon, nor shall it relieve them from the responsibility for error of any kind in Shop Drawings. When the Contractor does call such

deviations to the attention of the Architect/Engineer, they shall state in their letter whether or not such deviations involve any extra cost. If this is not mentioned, it will be assumed that no extra cost is involved for making the change.

D. After receiving approval on the make and type of materials, the Contractor shall order such materials in sufficient time so that no delay or changes will be caused. This is done to facilitate progress on the job and failure on the part of the Contractor shall render them liable to stand the expense of any and all delays occasioned by failure on this part to provide necessary details. All shop drawings shall be delivered to the Architect/Engineer's office within thirty (30) days from the date of the contract.

E. Shop drawings will be returned unchecked unless the following information is included: reference to all pertinent data in the Specifications or on the drawings, size and characteristics of the equipment, name of the project and a space large enough to accept an approval stamp. The data submitted shall reflect the actual equipment performance under the specified conditions and shall not be a copy of the scheduled data on the drawings.

1.7 SUBMITTALS

A. Submittal data shall be organized in commercial quality, three ring binders with durable and cleanable covers. Product information for each piece of equipment shall be separated by an indexing leaf with clear tabs. The product name and symbol (i.e., AHU/Air Handling Unit) shall be typed on white paper inserts and placed in an appropriate tab. Complete data must be furnished showing performance, quality and dimensions. A signed review by the Architect/Engineer must be obtained before purchasing any equipment.

B. The following items shall be submitted for review by the Architect/Engineer but are not limited to:

1. Air Conditioning Units
2. Fans
3. Diffusers, Registers and Grilles
4. Fire Dampers
5. Pipe Insulation
6. Duct Insulation
7. Coils
8. Temperature Controls
9. Cross Connection Control Devices
10. Plenum Materials and Supports

11. Hydronic Air Control Devices

12. Filter Assemblies and Filters

13. Flexible Pipe Connections

14. Roof Top Equipment

15. Ductwork Shop Drawings

16. Radiant Heating Equipment

17. Vibration Isolation Equipment and Calculations

1.8 QUALITY ASSURANCE

A. General: Comply with Division 1.

B. Welder Qualifications: Welders shall be certified by the American Society of Mechanical Engineers (ASME) National Certified Pipe for the type of work being performed. Current operators' certificates in accordance with ASME standards shall be on file at the site and shall be available to the Architect/Engineer for examination. Coupons shall be available for review by the Architect and Engineer.

C. Locations of all pipes, ducts, outlets, appliance, etc., as shown on the drawings, are approximate only and are understood to be subject to such revisions as may prove necessary or desirable at the time the work is installed. Each Contractor will be required to install their work with relation to existing building conditions and shall be entirely responsible for the correctness of their work with reference to finished elevations, etc. Piping shown on the drawings is diagrammatic only and their exact locations, depths, and invert elevations shall be as required for proper flow and coordination with other trades.

D. The contract drawing depicts graphically the arrangement of piping and ductwork. Should local conditions necessitate a rearrangement, or if any of the piping or ductwork can be installed to better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit three (3) copies of Drawings of the proposed arrangement for the Architect/Engineer's review.

E. If the Contractor proposes to install equipment, including piping and ductwork, requiring space conditions other than those shown, or to rearrange the equipment, they shall assume full responsibility for the rearrangement of the space and shall have the Architect/Engineer review the change before proceeding with the work. The request for such change shall be accompanied by Shop Drawings of the space in question.

F. Each Contractor is responsible for the proper location and size of all slots, holes, or openings in the building structure pertaining to their work, and for the correct location of pipe sleeves.

G. Each Contractor shall coordinate their work with that of all other trades that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines which require a stated grade for proper operation. Drainage lines shall take precedence over water lines in determination of elevations. In all cases, lines requiring a stated grade for their proper operation shall have precedence over electrical conduit and ductwork.

H. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Lubricate all equipment properly in accordance with manufacturer's instructions. Furnish zerk grease fittings on all greaseable bearings.

I. Equipment and Materials: The materials and equipment shall be new and shall be the standard products of the manufacturers regularly engaged in the production of Plumbing, Heating, Cooling, Ventilation, and Fire Protection Equipment, and shall be the manufacturer's latest standard design. Where two or more units of the same class of equipment are required, these units shall be the products of the same manufacturer. However, the component parts of the systems need not be the products of the same manufacturer. Specific equipment specified hereinafter is to be considered a standard of quality and operation. In general, all capacities of equipment, and motor and starter characteristics are shown in schedules on the drawings. Reference shall be made to the schedules for specific information. The capacities shown are minimum capacities. Variations in the characteristics will be permitted only on written approval of the Architect/Engineer. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Insofar as is possible all items of the same type (i.e., pumps, fans, etc.) shall be by the same manufacturer. Where installation instructions are not included in these specifications or on the plans, the manufacturer's instructions shall be followed. All equipment affected by altitude shall be rated to operate at the altitude where it is to be installed.

J. Excavation and Backfilling: This Contractor shall do all necessary excavation and backfill for the installation of the Mechanical systems as may be required. Curb cuts, asphalt and concrete patching, cutting and patching existing floor, etc., shall be part of this Contractor's responsibility. No extra payment will be made for rock excavation. Trenches for all underground piping shall be excavated to the required depths. The bottoms of trenches shall be tamped hard and graded to secure maximum fall. Bell holes shall be excavated to ensure the pipe resting for its entire length on solid ground. Should rock be encountered, it shall be excavated to a depth of 6 inches below the bottom of the pipe, and before laying the pipe, the space between the bottom of the pipe and the rock surface shall be filled with gravel, thoroughly tamped. Pipe laid in trenches dug in fill shall be supported down in the trenches and shall be filled. No roots, rocks or foreign materials of any description shall be used in backfilling the trenches. The backfill material shall be identical to the surrounding fill material and shall be placed in a 6-inch layer, wetted, and compacted to the density of the adjacent soil. See Division 2 for additional information for site utilities. All surplus materials shall be hauled from the project by the Contractor at their expense.

K. Cutting and Repairing:

1. Responsibility of the Contractor whose work is involved. Coordinate with others to prevent unnecessary cutting and repairing.

2. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports. Arrange with those whose work is involved to do cutting and replacing caused by negligence or error with costs reimbursed by the Contractor at fault. Cutting and replacing of existing work shall be the responsibility of the Contractor whose work is being installed.

3. Removal or terminating connections of existing work which is abandoned or replaced shall also be done hereunder to provide correct and finished work.

L. Foundations: All equipment shall be provided with suitable foundations and supports. It shall be the responsibility of the Contractor to provide for the proper locations of these foundations and supports. This applies to all rooftop equipment also.

1. All concrete foundations required by equipment furnished by the Mechanical Contractor shall be constructed by them (except where otherwise noted) the conformity with the recommendations of the manufacturer of the respective equipment, and with the approval of the Architect/Engineer. All corners of the foundations shall be neatly chamfered. Foundation bolts shall be placed in the forms when the concrete is poured. Allow 1 inch below the equipment base for alignment, leveling and grouting with nonshrinking grout. Grouting shall be done after the equipment is leveled in place. After the grout has hardened, the foundation bolts shall be pulled up tight and the equipment shimmed, if necessary. After removal of the forms, the surface of the foundation shall be rubbed.

2. Unless otherwise noted, foundations shall be a minimum of 6 inches high. All concrete work performed by these Contractors shall conform entirely to the requirements of the Concrete Specifications which describe this class of work.

M. Code Requirements: Comply with state and local code requirements and ordinances. Call for inspections required by responsible building inspection authority.

N. Applicable Building Codes and Ordinances: Including the latest edition of each code, but not limited to the following:

1. International Building Code.

2. Uniform Mechanical Code.

3. Uniform Plumbing Code.

4. Governing Fire Department Requirements

5. Utility Company Requirements

6. National Fire Protection Association Standards

7. NFPA 70 - National Electrical Code

8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

9. NEPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

10. NFPA 13 - Sprinkler Systems

11. NFPA 101 - Life Safety

12. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Laden Vapors from Commercial Cooking Equipment

13. International Energy Conservation Code 2021

O. Access Panels

1. Similar to Milcor, or as noted on the drawings, size as required for concealed expansion joints, valving, gauges, balancing dampers, valves, traps, pitot stations, equipment and similar items requiring accessibility. Notify the General Contractor of each access panel location and the required size. Panels shall be proper type for ceiling or wall in which they are installed. The panels shall be furnished under this section of the Specifications, unless otherwise directed, but shall be coordinated to be compatible with walls and ceilings furnished under other sections.

1.9 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1

B. Large Items: Make arrangements with other trades on the job for introduction into the building of equipment too large to pass through finished openings.

C. Acceptance: Check and sign for materials to be furnished by others for installation under all Mechanical Divisions upon delivery. Contractor shall be responsible for the storage and safekeeping of such materials from time of delivery until final acceptance.

D. Protection: Close ends of pipe and ductwork at the close of each working day during construction to prevent entry of foreign material. Protect insulation against dirt, water, chemical or mechanical damage before, during and after installation. Protect fixtures and equipment against damage during mechanical work with heavy paper or plastic until final clean-up.

E. Storage: Store equipment in covered enclosure or wrap with weather tight 6 mil Visqueen.

F. Shipping Protection: Protective casings, crating, and coverings to remain in place until start-up of equipment.

1.10 PROJECT CONDITIONS

A. Performance: All systems are to be rated at 7,500 ft. elevation.

1.11 SEQUENCING AND SCHEDULING

A. General: Comply with Division 1.

B. Schedule: Coordinate and order the progress of mechanical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit.

C. Utility Interruptions: Schedule mechanical utility interruptions with the Architect/Engineer/Owner minimum of seven (7) days prior to the requested outage. Plan work so that duration of the interruptions a maximum of one day.

1.12 CONTROLS WIRING AND ELECTRICAL EQUIPMENT

A. All mechanical equipment controls wiring, conduit, relays, interlocks, and all accessories required for a completely operational controls system shall be the complete responsibility of the mechanical contractor. The mechanical contractor has the option to hire the project electrical contractor or any qualified controls contractor to install mechanical controls wiring and conduit. Refer to Specification Section 253000 for coordination requirements between mechanical, electrical, and controls subcontractors.

B. Electrical items such as disconnect switches and motor starters associated with equipment provided by Division 23, when specifically mentioned to be furnished by the Mechanical Contractor, whether in these specifications or on the Electrical or Mechanical Drawings, shall be furnished by the Contractor. These items shall be mounted and connected as required for a completely operational system. See Control Systems Specification for further information.

C. All electrical equipment characteristics (voltage, etc.) must be verified by the Contractor prior to ordering. If the Contractor proposes to furnish motors varying in horsepower and/or characteristics from those specified, they shall first inform the Architect/Engineer of the change and shall then coordinate the change with the Electrical Contractor and shall pay all additional charges in connection with the change.

D. All motors shall meet all the requirements of all Electrical Divisions.

1. All motors shall be built in accordance with the current applicable IEEE, ASA, and NEMA standards. All general-purpose motors shall be open drip-proof machines for installation indoors and/or in protected locations.

Totally enclosed fan cooled (TEFC) motors shall be used in all areas of exposure to weather or other environmental contamination. All motors shall have copper windings. All motors to have minimum power factor of 85% or have switched correction to 90%. Unless indicated otherwise, motors shall be NEMA design B with a service factor of 1.15 with 40°C rise and total temperature rise of 65°C ambient and when powered from the system voltage feeding the motor. TEFC motors shall a service factor of 1.00 with total temperature is of 65°C in the above conditions. Motors located in areas exceeding 40°C ambient shall be factory-rated for the ambient temperature of the motor environment. Single phase motors shall generally be NEMA Type N split phase induction motors with built-in thermal protectors. Single phase motors connected on loads requiring high starting torque shall be capacitor-start induction motors. Single phase motors of 1/10 HP or less may be shaded pole induction motors.

1.13 PROTECTION AGAINST HAZARDOUS CONDITIONS

A. The Contractor shall take precautions against hazardous construction conditions at all times during construction. The final condition of the facilities shall be safe, and where safety to operating personnel is jeopardized, suitable signage shall be posted.

B. Protruding metal (bolts, steel angles, etc.) potentially hazardous to maintenance and operating personnel, shall be cut back and/or protected to reduce the risk of injury. All openings between floors shall be protected with barriers around the openings, gratings across the openings, or steel bars through the openings to avoid and protect against injury.

1.14 HAZARDOUS SIGNS

A. Equipment room contains moving or rotating parts, floor openings, or other potentially hazardous environments and shall include a sign on the door entering it that shall read similar to the following: **Hazardous Area - Authorized Personnel Only.**

1.15 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Mechanical Contractor shall furnish to the Owner a bound (three (3) ring binder) manual in triplicate, containing complete repair parts lists, and operating, service, and maintenance instructions on all mechanical equipment, fixtures, and systems, as noted below:

1. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

2. For Each Product System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.

3. Product Data: Mark each sheet to clearly identify specific product and component parts, and data applicable to installation. Delete inapplicable information.

4. Warranties and Bonds: Bind in copy of each.

5. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

6. Include color-coded wiring diagrams as installed for control system.

7. Operating Procedures: Include start-up, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

8. Maintenance Requirements: Include routine procedures and guide for troubleshooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

9. Provide servicing and lubrication schedule and list of lubricants required.

10. Include manufacturer's printed operation and maintenance instructions.

11. Include sequence of operation by controls manufacturer.

12. Provide original manufacturer's part list, illustrations, assembly drawings and diagrams required for maintenance.

13. Provide control diagrams by controls manufacturer as installed.

14. Provide charts of valve tag numbers, with locations and functions of each valve, keyed to flow and control diagrams.

15. Provide list of original manufacturer's spare parts and recommended quantities and to be maintained in storage.

16. Include Test and Balance (T&B) Reports as specified in Section 23 0593.

B. The Mechanical Contractor shall also provide training as required by Section 23 0100 to the Owner's operation and maintenance personnel.

1.16 OPERATION PRIOR TO ACCEPTANCE

A. The Owner shall have the right to operate any and all apparatus as soon as and as long as it is in operating condition, after Owner personnel have received operational training, whether or not such apparatus has been accepted as complete and satisfactory, except that this shall not be construed to mean operations before any required alterations or repairs have been made. This

operation does not indicate acceptance of the equipment by the Owner. When the Contractor enters into a contract with the Owner, they agree to the above.

1.17 WARRANTY AND SERVICE PROGRAM

A. Due to the critical performance requirements and to clearly establish warranty responsibility for this project, the Contractor shall provide a full-service maintenance and warranty program to the Owner for one full year after beneficial occupancy (substantial completion).

B. This service program shall be included as part of the base bid and shall include service, maintenance, repair, replacement, lubrication, temperature control calibration and repairs, and documenting proof for all service and maintenance work on all equipment and system furnished by the Contractor.

C. A single representative in the employment of the Contractor shall be responsible for coordination and follow through of this program. This representative's name and phone number shall be submitted to the Owner as part of the maintenance manuals and supportive data. The Contractor shall respond to a request for service with 24 hours if so requested.

D. During this first year of operation, the following sequence of maintenance service shall be performed as a minimum.

1. Controls shall be calibrated throughout the facility at the end of six (6) months (following substantial completion). Any leaks in the piping systems shall be repaired.

2. All equipment manufacturer's service recommendations shall be followed during this period.

1.18 FLUSHING AND DRAINING

A. It shall be the responsibility of this Contractor to properly drain and flush all ducts and pipes before use or acceptance to ensure that all debris is completely removed. Damage caused by such debris remaining in the ducts or pipes shall be repaired by this Contractor at their expense. This Contractor shall demonstrate to the Architect/Engineer's representative that all piping is clean.

1.19 CLEANING

A. This Contractor shall remove from the building construction site all rubbish and dirt as it accumulates under the contract. At completion, all areas shall be broom cleaned and all obstructions, surplus materials, etc., removed.

1.20 GUARANTEE

A. The Contractor shall guarantee all materials, equipment, and workmanship furnished and installed by them under this Contract, to be free from all defects of workmanship and materials, and shall agree to replace at their expense, without expense to the Owner, at any time within one year after installation is accepted

by the Architect/Engineer, any and all defective equipment, parts, etc., that may be found. (This excludes normal maintenance and daily servicing of equipment which is the Owner's responsibility.)

1.21 FLOOR, WALL, AND CEILING PLATES

A. Where exposed pipes pass through floors, finished walls, or finished ceiling, they shall be fitted with chromium-plated escutcheons of an approved pattern. Escutcheons and plates in Mechanical Rooms do not require chrome finish.

B. This Contractor shall be responsible for providing and installing all counter flashing. All openings in the roof shall be flashed and counterflashed. Use four-pound lead flashing materials for all vent lines and welded flashing in steel lines passing through roof. The Mechanical Contractor shall notify the General Contractor where each roof penetration is and the size of the opening.

1.22 PIPE SLEEVES

A. Schedule 40 steel pipe sleeves or pipe sleeves made of No. 20 gauge galvanized steel, properly secured in place with approximately 1/4" space between each sleeve and the surface of the pipe and/or insulation passing through it, shall be provided for all pipes passing through concrete floors, roofs, and masonry walls. All pipe sleeves shall be fixed in place as the walls and floors are built up. The Contractor shall furnish and locate all sleeves and pipes passing through concrete floors, exterior masonry walls, and roofs shall be made watertight with approved non-hardening plastic material. Sleeves through pipe chase or equipment room floors shall project a minimum of 2 inches above the floor and shall be of black steel pipe with waterproof flange at center of floor thickness. Each sleeve through a fireproof wall shall be packed with approved fireproof rope in the annular space.

1.23 PIPE HANGERS

A. Pipe hangers shall be Fee and Mason of a type suitable for each use. Perforated straps shall not be used in any work. For ferrous pipes up to and including 4 inch in size, use Fee and Mason Fig. 199 malleable iron, adjustable, split ring, swivel hanger. For plumbing piping larger than 4 inches, use Fee and Mason Fig 239 steel clevis hanger. Where several pipes are parallel at the same elevation, trapeze hangers may be used. Where trapeze hangers are used, the pipes shall be supported on rollers where indicated on the Drawings. For copper pipes up to and including 3 inches in size, use Fee and Mason Fig. 360 malleable iron, copper plated hangers. For copper pipes larger than 3 inches, use Fee and Mason Fig. 364 copper plated clevis hanger.

B. Hanger rod sizes shall conform to the following schedule:

1.	Pipe up to and including 2"	3/8" rods
2.	Pipe 2-1/2", 3" and 3-1/2"	1/2" rods
3.	Pipe 4" and 5"	5/8" rods

C. Unless shown otherwise on the Plans, all horizontal runs of ferrous piping shall be suspended from the floor or roof construction, as the case may be, by means of hangers with the following spacing:

1.	Pipe up to and including 1-1/4"	8'
2.	Pipe 1-1/2" and 2"	10'
3.	Pipe 2-1/2" and 3"	12'
4.	Pipe 3 1/2” and 4”	14’

D. Unless shown otherwise on the Plans, all horizontal runs of copper piping shall be suspended from the floor or roof construction as the case may be, by means of hangers with the following maximum spacing:

1.	Pipe up to 3/4" in size	5'
2.	Pipe 1" and 1-1/4"	6'
3.	Pipe 1-1/2" and larger	10'

E. There shall be a hanger within 2 inches of each elbow or tee. Additional supports shall be provided for valves, strainers, etc. Cast iron pipe shall have not less than one hanger per length of pipe. Vertical risers shall be supported by approved riser clamps at each floor. Vertical pipes within a space shall have not less than two supports.

F. Supports and hangers shall be installed to permit free expansion and contraction in the piping systems. Hangers shall permit vertical adjustment to maintain proper pitch. Where necessary to control expansion and contraction, the piping shall be guided and firmly anchored. No piping shall be self-supporting, nor shall it be supported from equipment connection.

G. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

H. Expansion bolts shall be Ackerman-Johnson or Hilti.

I. Beam clamps suitable for use with this type of steel construction involved shall be Grinnell.

1.24 PRESSURE VESSEL CERTIFICATION

A. Not used.

1.25 ISOLATION

A. Excessive vibration or objectionable noise created in any part of the building by the operation of any equipment furnished and/or installed under the Mechanical Contract will be extremely objectionable and the Contractor shall take all precautions against the same by isolating the various items of equipment from the building structure and by such other means as may be necessary to eliminate all excessive vibration and objectionable noise produced by any equipment installed by them, and consequently, they shall design all foundations, supports, etc., for their equipment, and all piping with this end in view. In addition, these Contractors shall supervise the construction of all foundations and supports, whether they build them or not, in order that they may be constructed in such a manner as to prevent the transmission of objectionable noise and/or excessive vibration. Submit calculations on all vibration isolation equipment.

B. All equipment having moving parts shall be isolated from the building structure by means of Korfund isolation materials, unless specifically noted otherwise. All isolators shall be the same brand and shall be supplied from the same source. Equipment manufacturer's recommendations shall be followed in the isolation of equipment.

C. Vibration isolators shall have sufficient resilience to meet the following minimum efficiencies:

Motor HP	Equipment Room
Up to 5	90%
7-1/2 to 15	93%
20 to 40	95%
50 to 100	97.5%

D. Spring isolators shall be of the housed type with ribbed pads bonded to the underside of the baseplate, or may be unhoused stable springs. Isolators shall be furnished with snubbers and limit stops where so recommended by the equipment manufacturer.

E. The Supplier of the isolating equipment shall, upon completion of the job, check all isolating materials and verify that they are installed properly, and submit a report in writing to the Architect/Engineer.

1.26 TESTING

A. Before completion of this project, the Mechanical Contractor shall test all materials and equipment which normally require testing. All piping, etc., shall be tested to meet code requirements or the Specification requirements, whichever is more stringent.

B. All equipment shall be operated sufficiently long enough to prove to the Architect/Engineer that the equipment performs satisfactorily and meets the requirements set forth on the Plans or in these Specifications.

1.27 CERTIFICATIONS

A. Before receiving final payment, the contractor shall verify that all equipment furnished and all work done is in compliance with all applicable codes mentioned in these Specifications. Submit certifications and acceptable certificates to the Architect/Engineer.

1.28 GENERAL PIPING INSTALLATION REQUIREMENTS

A. Provisions for Drainage: All piping systems shall be installed so that they may be easily drained. Drain caps, plugs, or hose bibbs shall be installed at low points. Grade piping toward drain locations.

B. Alignment: All installed pipelines shall be straight and shall remain straight against strains. Proper allowance shall be made for expansion and contraction.

C. Clean as Installed: All piping shall be kept free from scale or loose dirt when installed, and must be kept clean during the completion of the installation. All openings in the piping system shall be capped or plugged while awaiting further connections. All detergents, solvents and other cleaning agents shall be compatible with the materials of fabrication of the system in which they are used. They shall not adversely affect the materials of mechanisms in the systems and they shall be acceptable to equipment manufacturers. All detergents, solvents, and other cleaning agents shall also be compatible with the process streams to be handled by the systems in which they are used.

D. Insulated Fittings: Install between any dissimilar metals such as steel and copper.

E. Expansion and Contraction: The Contractor shall make all necessary provisions for expansion and contraction with proper fittings, anchors, dresser couplings, loops, etc. Install flexible connectors on each pipe at each building expansion joint.

F. Welding: Refer to Paragraph 1.29 of this section of these specifications.

G. Bending: No bending of pipe will be permitted.

H. General: The installation shall be coordinated with respect to space available with heating, cooling, ventilating, and electrical installation. In every instance where there is a conflict in the routing of the piping and the ducting, the routing of the ducting shall govern. Installed piping shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural

members to facilitate piping, installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping above ground shall be run parallel with the lines of the building unless otherwise noted on the drawings. Unless otherwise shown on the drawings, horizontal piping shall pitch down in the direction of flow with grade of not less than 1 inch in 40 feet. Piping connections to equipment shall be in accordance with details shown on the drawings or as recommended by the equipment manufacturer. Service pipe valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 1/2 inch from such other work, and not less than 1/2 inch between finished covering on the different services.

I. Installation of Valves: Valves shall be installed at the locations shown on the drawings and where specified and where directed at site. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with their stems horizontal or above. Where tight shutoff is required, a composition seat globe valve or resilient seat ball valve shall be used.

J. All valves which must be used during operation, all control valve assemblies, instrument control cases, liquid level controls, gage glasses, orifices, relief valves, and other equipment which must be observed, adjusted, or serviced during operation shall be located conveniently accessible from an operating platform or grade.

K. In general, relief valves within processing unit limits shall be located conveniently accessible from an operating platform or grade.

1. Those in non-hazardous service, such as water, shall discharge directly to outside.

2. Relief valves should have no piping between the vessel or line and the valve inlet, except as shown on the drawings.

3. Relief valves shall be installed in a vertical position. Vent piping shall be braced and supported in a manner that will not produce excessive stresses in the relief valve and will permit removal of the relief valve without necessary temporary supports for the vent lines.

L. Equipment Connections: All piping connections to pumps and other equipment shall be installed without strain at the pipe connection of the equipment. The contractor shall be required as directed to remove the bolts in flanged connections or disconnect piping to demonstrate that the piping has been so connected. Pipe connections to equipment shall be made with unions or flanged fittings. Provide removable headers for large equipment for service access.

M. Joints

1. Flanged Joints: All flanged joints shall be face matched. Raised face flanges shall not be mated to flat-faced cast-iron flanges on valves or equipment. The raised face must be turned off. All flanged bolt holes shall straddle the horizontal and vertical center line unless otherwise noted.

2. Screwed Joints: Screwed pipe joints shall have American Standard Taper Pipe Threads ANSI-B2.1 Latest Edition. Burrs formed when cutting pipe shall be removed by reaming. Care shall be taken that the inside of pipe is thoroughly clean and free of cutting oil and foreign matter before installation. Joints shall be made perfectly tight by the use of Teflon tape or approved Teflon thread sealing and lubricating compound.

3. Solder-Joints: Tubing shall be cut square and burrs removed. Both inside of fittings and outside of tubing shall be well cleaned with steel wool or wire brush before seating. Care shall be taken to prevent annealing of fittings and hard drawn tubing when making connections. Joints for serrated fittings on water, compressed air below 60 psig, and vacuum lines shall be made with a 95 percent tin and 5 percent antimony. Cored solder or solder containing lead will not be permitted.

N. Reducers: Reduction in pipe size shall be made with one piece reducing fittings. Bushings reducing at least two pipe sizes will be acceptable only when there is no room for reducing couplings or swaged nipples.

O. Unions: All piping unions shall be of the ground joint type constructed from materials equivalent in alloy composition and strength to other fittings specified with which they are used. Union Pressure classes and end connections shall be the same as the fittings used in the lines with the unions. Steel unions shall have hardened stainless steel seating surfaces on both faces.

P. Hanger Supports:

1. All hanger rods used to support piping, conduit, mechanical units, equipment, trapezes and other items shall be straight and installed plumb, regardless of length. Do not bend rods to adapt to sloped or rotated structural members, secondary support members or to sloped mounting holes on supported equipment. Contractor shall utilize available swivel, hinged, or rigid mounting techniques designed to accommodate a slope or rotation, or shall design a custom solution. Selected techniques for each application shall be submitted for approval prior to use.

2. Do not bend rods to circumvent an obstruction.

3. Loads on hanger rods shall be applied in direct tension. Do not apply compression, lateral or moment loads to hanger rods. Install bracing or additional supports to prevent hanger rod from incurring non-tension loading.

4. Do not create offsets in rods; use only in-line couplers, and only when length of coupled rod exceeds standard available length (typically 12 feet), or when full lengths cannot be placed in position. Provide additional horizontal bracing to prevent swaying of supported piping or equipment.

5. Do not straighten bent rods for subsequent use. If a rod becomes bent, cut off and discard the bent portion. Remaining straight portion of rod may be used.

1.29 WELDING

A. All welding of piping covered by this specification, regardless of condition of service shall be accompanied as follows:

1. The welding shall be in accordance with the recommendations of the American Welding Society. Mitering of pipe to form elbows, notching to form these, or any similar construction will not be permitted. Welding fittings shall be installed on all welded lines. Joints to be welded shall be properly aligned and spaced, using special welding clamps where necessary. All welders to be employed shall have passed qualification tests prescribed by the National Certified Pipe Welding bureau (or by another reputable testing laboratory or agency) using procedures approved by the American Society of Mechanical Engineers or the American Welding Society. The welders will be required to pass qualification tests when the work of the welder creates a reasonable doubt as to their proficiency. Tests shall be conducted at no additional expense to the Owner.

2. Each welder shall, in addition to having passed the prescribed qualification tests (as noted in Paragraph 1.29.A.1), prepare sample coupons at the job site on a portion of pipe that is cut such that the cross section of the weld is open to view. The sample weld should be prepared using a 6-inch diameter pipe. The sample shall reflect a continuous weld with perpendicular cut out to show the weld in cross sectional view. This sample, when accepted and approved by a certified welding inspector, shall be used as a standard of quality to compare to other welds that this welder will be performing on the job. This same sample weld will also be a basis for accepting or rejecting the welder for working on this project. The sample weld shall be identified with a date and the welder's name and shall be kept at the site throughout the project.

3. All welding on pressure piping shall conform to all of the requirements of the American Society of Mechanical Engineers Code for Pressure Piping - B31.1 (An American National Standards Institute publication), as defined in the latest edition of the ANSI Power Piping B31.1 Manual. All welding shall also conform to all of the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. All chapters, current addenda and supplements of these manuals shall apply. This code shall be used to establish standards of performance and quality of welds. However, the Owner reserves the right to perform radiographic testing of all welds, to compare any of the welds to the approved "standard" sample welds of each welder, and to compare the welds to the welding diagrams and sketches of those recommended in the ANSI B31.1 Power Piping Manual. The intent is to obtain the highest quality welding job possible. The cost of any initial radiographic testing, for random inspection, shall be paid for by the Owner. If radiographic random testing reveals that a weld is defective, the Contractor shall bear the cost of all repairs and re-testing necessary to be made to subject weld until conformance with radiographic tests is reached. The potential for random radiographic testing and welding quality control applies to all pressure

piping systems in this project, including systems below 100 psig. If a question should arise regarding the possibility of faulty welding or if there are obvious visual defects in the welding, the Contractor shall be required to correct such deficiencies to a quality level consistent with the recommendations, welding diagrams and sketches in the ANSI B31.1 Manual. The quality level shall also reflect that of the approved sample welds accomplished by each welder for this particular project.

1.30 TESTING FOR PIPING SYSTEMS

A. General: Before insulation is applied, all piping, equipment, and accessories installed under this contract shall be inspected and tested by the Contractor. All labor, material, and equipment required for testing shall be furnished by the Contractor. The Contractor shall be responsible for all repairs and retesting as required. All instruments and other equipment whose safe pressure range is below that of the test pressure shall be removed from the line or blanked off before applying tests. Prior to performing tests, all lines shall be "blown" free of all loose dirt and foreign particles. The lines shall then be thoroughly flushed with water (liquid lines only) at a sufficient flow rate and period of time to ensure complete cleaning of the lines of all dirt, scale, and foreign matter. Satisfactory flushing of the lines shall be subject to approval. After testing and flushing lines, all filters and strainers shall be cleaned.

B. Safety: Since the Risk of failure, with the attendant possibility of injury, is appreciable greater with further testing, all safety measures required by codes or ordinance or reasonable applicable to the situation shall be taken.

C. Concealment: Equipment or piping to be pressure tested shall not be insulated, covered, or concealed prior to that test. Compression joint underground piping may be backfilled prior to pressure test except that joints shall remain exposed until after the test, but tie rods, clamps, etc., shall be in place and fastened.

D. Pressure Ratings: These tests shall not be used to establish pressure ratings.

E. System Protection: Protect all piping and equipment against overpressure, collapse from vacuum, and hydraulic shock during the filling, testing and draining procedures. Seats of iron valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Pressure tests against other closed valves shall not exceed twice the normal rating. Note that where significant differences in elevation exists, there is a risk of overpressure in the lower portions of the system in order to attain test pressure in the upper portion of the system

F. Test Temperature: Apply test pressure only after the system and test medium are at approximately the same temperature, preferably not less than 60°F. Note that some applicable codes require testing above a specified minimum temperature.

G. Sectionalizing: Systems may be separated into sub-systems for testing if such action will expedite or simplify the testing.

H. Temporary Supports: During hydrostatic testing of lines provide temporary supports to prevent overstressing supports or hangers. When tests are completed, remove all temporary supports, locks, stops, etc., and adjust supports for their cold load and alignment.

I. Testing: Domestic hot and cold water piping and heating water piping shall be tested hydrostatically at the test pressures specified and shall show no drop in pressure in a 2-hour period. Leaks shall be located by soap testing

J. Test Report

1. A detailed report of pressure tests on piping and equipment shall be forwarded in duplicate to the Architect/Engineer. This report shall show date of test, lines tested, test medium, length of time test pressure was held, pressure drop or rise, and extent of venting or repressurizing.

1.31 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other sections of these specifications covering the work of other trades which must be carried out in conjunction with the mechanical work so that the construction operations can proceed without harm to the Owner from interference, delay or absence of coordination.

1.32 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the mechanical work at the building. No extra compensation shall be claimed or allowed on account of difference between actual dimensions and those indicated on the drawings. They shall examine the adjoining work on which Mechanical work is dependent for maximum efficiency, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting Mechanical work.

1.33 SAFETY GUARDS

A. The Mechanical Contractor shall furnish and install safety guards required in order to obtain certificates of inspection from all authorities having jurisdiction. All belt driven equipment, projecting shafts, and other rotating parts shall be enclosed or adequately guarded. Provide coupling guards on all rotating shafts.

1.34 PROTECTION

A. All work, equipment, and materials shall be protected at all times to prevent obstruction, damage, or breakage. All pipe openings shall be closed with caps or plugs during installation. All equipment shall be covered and protected against dirt, water, chemical, or mechanical injury. At the completion of the work, all equipment shall be thoroughly cleaned and the entire system shall be delivered in a perfect, unblemished condition.

1.35 PAINTING AND IDENTIFICATION

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be marred in transit or during installation, it shall be finished to present a neat, workmanlike appearance.

B. Except as elsewhere hereinafter specifically required, any painting of equipment, piping, ductwork, grilles, insulation, etc., furnished and installed under this Section of the Specifications will be done by the Painting Contractor. However, the Mechanical Contractor shall leave their equipment clean and free from any grease, dirt, rust, etc., and in suitable condition for painting.

C. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during the painting operation.

D. The piping shall be painted the basic color as indicated in other sections of these specifications and shall be marked every 10 feet on centers with Brady pipe markers. Arrows, approximately 6 inches in length and spaced about 10 feet on centers shall indicate the direction of the flow pipe. Locate additional labels as required in Mechanical Rooms. Staple in place, brush with clear lacquer. Markers shall state pipe size, flow direction, and pipe usage (such as "cold water," etc.).

1.36 RECORD DRAWINGS

A. The Contractor shall, during the execution of the work, maintain a complete set of drawings upon which all dimensional locations of equipment piping and all deviations and/or changes in the work shall be recorded. Water, storm, and drainage mains shall be delivered to the Architect/Engineer in good condition upon the completion and acceptance of the work and before final payment is made.

1.37 SUPPLIER RESPONSIBILITY

A. Each supplier, whether furnishing equipment as specified or as a substitution shall be responsible for certifying that the equipment is properly installed and that the warranty is valid. Submit written reports on the installation and the equipment performance when requested to do so by the Architect/Engineer (or their representative). Each supplier shall be responsible for furnishing qualified personnel at the job site at any time requested by the Architect/Engineer (or their representative) during the construction or warranty periods.

END OF SECTION

SECTION 23 0519
PIPING SPECIALTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish and install all piping specialties necessary for satisfactory operation of the systems.

B. Manual air vents shall be installed at all high points in heating and cooling water piping systems and as shown on the contract drawings.

C. Valves shall be installed in all primary and secondary plumbing loops and branch lines feeding groups of fixtures in order to isolate such loops and branches without disrupting the service as a whole.

D. Unions shall be installed where necessary to facilitate maintenance of pumps, valves, regulators and other specialties.

E. Dielectric unions shall be installed wherever dissimilar metals are joined, except valves in closed loop piping systems.

1.3 RELATED WORK IN OTHER SECTIONS

22 0523	VALVES
22 0700	PIPING INSULATION
22 1000	PIPE AND PIPE FITTINGS
22 1113	DOMESTIC WATER SYSTEMS
22 1313	SOIL AND WASTE PIPING SYSTEMS
23 0000	HEATING, VENTILATING, AND AIR CONDITIONING INDEX
23 0500	GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS
23 0548	VIBRATION ISOLATION AND EXPANSION COMPENSATION

PART 2 – PRODUCTS

2.1 STRAINERS

A. Mueller Steam Specialty model 352M cast bronze, threaded ends, y-strainer, 20 mesh stainless steel screens for water service and .033” dia. opening screens for steam service. Provide blow-off valves full size of strainer tapping with drain lines to nearest drain.

B. Mueller Steam Specialty model 752, 250 SWP, flanged for size 2-1/2” and larger with 1/16” dia openings screen for water and 3/64” dia openings stainless steel

screen for steam. Provide blow-off valves full size of strainer tapping with drain lines to nearest drain.

2.2 PRESSURE GAUGES

A. Marshalltown “Permagage”, Ashcroft “Duragage”, “Trerice No. 500X, or approved equal. Dials shall be 4-1/2” unless otherwise noted. Proved needle valve for each gauge, and syphon for each steam gauge. Pressure gauges shall be range noted on plans or at mid range of service (as shown on drawings).

2.3 THERMOMETERS

A. Where indicated on the drawings and the piping diagrams, thermometers shall be installed as manufactured by the H.O. Trerice Co., Mueller, Albert Weiss, or approved equal. Thermometers shall be provided with expansion heads so that thermometer will not break under extremes of temperature. Each thermometer shall be provided with a separable socket well which shall be place in the piping system. The well shall be the length required for accurate reading of the thermometer.

2.4 AIR VENTS

A. Manual air vents shall be 1/2” brass ball valves, Nibco No. T-585-70 or approved equal.

2.5 THERMOMETER WELLS

A. Machined brass test wells with screwed caps and chains. H.O. Trerice No. 5573 or 5574 as required, or approved equal.

B. Temperature and Pressure Test Plugs: Furnish pressure and temperature test plugs at all locations as shown on the drawings and at every connection to each piece of equipment. These test plugs shall be furnished with a Nordel valve core and 1/2” NPT brass body complete with gasket cap.

C. Furnish 4 each thermometers and pressure gauges for use by the Owner for checking temperatures and pressures.

2.6 INSULATING UNIONS

A. Insulating unions having a plastic insert for electrical isolation shall be similar to EPCO Sales Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All specialties shall be installed in accordance with the best standard practices and as recommended by the manufacturer.

B. Where thermometers or test fittings occur in insulated piping systems or on insulated equipment, extension necks shall be provided to extend beyond the insulation. See drawings for locations.

C. Dielectric union shall be installed wherever piping of dissimilar metallic material is connected. Insulating unions are not required between bronze valve bodies and connecting steel pipe in closed loop systems such as heating and chilled water systems.

D. Strainers shall be installed in direction of flow with valved plugged a minimum of 6” from strainer. Strainers shall be installed ahead of coils, equipment, etc. whether or not shown on drawings for all HVAC equipment. Strainer shall be on outlet side of pumps and similar equipment.

E. Air vents shall be installed at all high points in hydronic systems for heating water and chilled water piping system.

END OF SECTION

SECTION 23 0548
VIBRATION ISOLATION AND EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Vibration Isolation: All vibration isolation equipment including flexible pipe and duct connections hangers and bases shall be under the direct supervision of the vibration isolation manufacturer's representative. This specification provides the necessary design criteria to avoid excessive noise or vibration due to the operation of machinery, connecting piping, ductwork or conduit.

1.3 RELATED WORK IN OTHER SECTIONS

22 0523	VALVES
22 0700	PIPING INSULATION
23 0000	HEATING, VENTILATING, AND AIR CONDITIONING INDEX
23 0500	GENERAL HEATING, VENTILATING, AND AIR CONDITIOING REQUIREMENTS
23 0519	PIPING SPECIALTIES

1.4 CONTRACTOR RESPONSIBILITY

A. The Contractor shall provide a submittal to the Architect/Engineer for approval prior to any installation of his equipment containing the following information:

1. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with this specification and the recommendation of the isolator manufacturer as to suitability for the specific service.

2. An itemized list showing the items of equipment, piping and ductwork to be isolated, the isolator type and model number selected, isolator loading and deflection, and reference to specific drawings showing equipment frame construction where applicable.

3. Drawings showing equipment frame construction for each machine, including dimensions, structural member sizes, support point locations, etc.

4. Written approval of the frame design to be used, obtained from the equipment manufacturer.

5. Drawings showing methods of suspension, support, guides, etc., for piping and ductwork.

6. Drawings showing methods for isolation of piping and ductwork piercing walls, slabs, beams, etc.

7. The Contractor shall bring to the Architect/Engineer's attention prior to installation any conflict with other trades which will result in unavoidable contact to the equipment, piping, etc., described herein, due to inadequate space. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

8. The Contractor shall bring to the Architect/Engineer's attention any discrepancies between the specifications and field conditions, changes required due to specific equipment selection, etc., prior to installation. Corrective work necessitated by discrepancies after installation shall be at the expense of the Contractor.

9. The Contractor shall obtain inspection and approval from the Architect/Engineer of any installation to be covered or enclosed prior to such closure.

10. The Contractor shall obtain written and/or oral instructions from the vibration isolation manufacturer as to the proper installation and adjustment of vibration isolation devices; alternatively, the equipment may be installed by the vibration isolation manufacturer.

11. The Contractor shall correct, at no additional cost, all installations which are deemed defective in workmanship or materials by the contracting officer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Vibration isolation equipment shall be as manufactured by Flexonics, Kinetics, Mason Industries, Vibration Eliminator, Co., or approved equal.

2.2 ISOLATOR TYPES

A. Spring Type

1. All spring isolators shall have either known undeflected heights or other markings so that, after adjustment, when carrying their load the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

2. All spring isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range 50% above the design deflection.

3. The ratio of lateral to vertical stiffness shall not be less than 1.0 or greater than 1.6.

4. The vertical natural frequency for each support point, based upon the load per isolator, and isolator stiffness, shall not differ by more than plus or minus 10%.

5. Type MS shall be bare spring type (without housings or snubbers) equipped with leveling bolts and with two layers of ribbed or waffled neoprene pad separated by a 1/16 " galvanized steel plate under the base plate.

6. Type HS shall be suspension hanger having a steel frame and spring element in series with a neoprene pad or washer. The isolator shall be designed so hanger rod may be misaligned 15 relative to the vertical without touching hanger box frame.

B. Neoprene Pad Type

1. Type MN shall be a neoprene isolator unit having a minimum static deflection of 1/4" and show hardness of 40 to 65 after minimum aging.

C. Flexible pipe connectors shall consist of a minimum 12 inch length of metal reinforced or corrugated flexible metal hose of appropriate pressure and temperature rating with end connections suitably for the adjacent piping system. Connectors shall be Flexonics type MMT FLG or Vibrasorber or approved equal.

D. Flexible duct connectors shall be neoprene coated glass fabric, ventglass or equal. See Section 23 3000 - AIR DISTRIBUTION.

2.3 EQUIPMENT FRAMES AND BASES

A. General:

1. Equipment frames and base shall be furnished and installed where specifically shown on the drawings and at other locations recommended by the isolator manufacturer. In general rigid steel frames will be required for base mounted pumps, 30 HP and smaller, air handling units, some fans 30 HP and smaller, water chillers, cooling towers. Concrete inertia bases shall be furnished and installed for base mounted pumps 40 HP and larger and fans 40 HP and larger.

B. Rigid Steel Frames

1. Mounting frame and/or brackets shall be provided to carry the load of the equipment without causing mechanical distortion or stress to the equipment.

2. The mounting frames shall consist of welded wide flange of channel structural steel with welded brackets to accept the isolators. The section depth of the frame member shall be greater than 1/10 the length of the longest frame member.

PART 3 - EXECUTION

3.1 GENERAL

A. Location: Vibration isolation equipment shall be installed at the following locations and at other locations recommended by the isolator manufacturer or required to reduce transmitted vibrations to a level acceptable to the Architect/Engineer and Owner.

1. All reciprocating or rotating equipment such as fans, AHU's, forced draft boilers, chiller, cooling towers, furnaces, pumps and compressors except as follows:

a) Equipment installed on slab on grade construction.

b) AHU's having factory installed internal spring isolation at fans.

c) Inline pumps having motors 1/2 HP or smaller.

2. At all connections between rotating equipment and piping or ductwork.

3. All piping and ductwork within mechanical equipment rooms or within 10 feet of connections to rotating or reciprocating equipment.

B. The Contractor shall install equipment and piping avoiding rigid contact with the building structure.

C. The Contractor shall coordinate his work with other trades to assure rigid contact between the building structure and mechanical equipment and piping is minimized.

3.2 INSTALLATION

A. Large Equipment

1. Objective: Installation of vibration isolators shall not result in any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. Equipment shall be shimmed into final, loaded position prior to making piping connections. Equipment load shall not be transferred to the isolator until the installation is complete and the equipment is under full operational load. This is particularly important where equipment installation weight is substantially different from operating weight such as cooling towers, chillers, boilers, air washers and evaporative coolers which operate with substantial water content.

2. The machine to be isolated shall be supported by a structural steel frame or concrete inertia base.

3. Brackets shall be provided to accommodate the isolator and provide a mechanical stop. The vertical position and size of the bracket shall be specified by the isolator manufacturer.

4. The operating clearance at steel frames between the bracket and the pad or floor shall be 3/8 inch, plus or minus 1/16 inch. The minimum operating clearance between the frame and the housekeeping pad or floor shall be one inch.

5. The frame shall be placed in position and the brackets supported temporarily by 3/8-inch shims prior to the installation of the machine or isolators.

6. The isolators shall be installed without raising the machine and frame

7. After the entire system installation is completed and under full operational load, the isolator shall be adjusted so that the load is transferred from the shims to the isolator. When all isolators are properly adjusted the shims will be barely free and shall be removed. Thereafter, the shims will be used as a gauge to check that the 3/8-inch clearance is maintained so that the system will remain free of stress.

B. Pipe And Duct Hangers

1. General: Vertical rise and horizontally supported piping connected to reciprocating or rotating equipment are included herein. Domestic water and fire standpipe systems are excluded from this section of the specifications.

2. Pipe and duct hangers shall be suspended from spring isolators within mechanical equipment rooms and within 10 feet of connections to rotating or reciprocating equipment.

3. The isolators shall be installed with the isolator hanger box as close as possible to the structure.

4. The isolators shall be suspended from substantial structural members, not from slab diaphragms unless specifically approved.

5. Hanger rods shall be aligned to clear the hanger box.

6. Horizontal suspended pipe 2" and smaller shall be suspended by HS isolator type with a minimum 1.0-inch static deflection. Pipes larger than 2" shall be the same except with a minimum of 1-1/2" static deflection.

7. Horizontal pipe floor supported at slab shall be supported via Type MS with a minimum static deflection of 1.0 inch.

8. Vertical riser pipe supports shall utilize Type MS mounts selected for a minimum static deflection of 1.5 inches.

9. Vertical riser guides, if required, shall utilize Type MN mounts to avoid direct contact of piping with building.

10. Pipe sway braces where required shall utilize two neoprene elements (Type MN) to accommodate tension and compression forces.

11. Hanger rods for all equipment, pipes, ducts, trapezes, vibration isolators, etc., shall be installed straight, true and plumb. Do not bend or flex hanger rods to accommodate sloping structures, avoid obstacles, or for any other purpose. Where necessary, utilize swivel beam clamps, beveled or swivel hardware, angled, swivel or hinged brackets spanning members or other appropriate means of connection.

C. Pipe Clamps:

1. All piping whether or not spring isolated hangers are used, shall be supported with a resilient wrapping or clamp system employing a resilient element of wool felt, neoprene or other suitable material.

D. Flexible pipe connectors shall be installed between each piece of rotating or reciprocating piece of equipment and the distribution piping system.

E. Flexible duct connectors shall be installed between each unit containing a fan and the distribution ductwork. Allow at least 1" slack in fabric connectors. Fabric may be attached to ductwork by folding into the sheet metal or attaching with metal flanges.

F. Flexible duct connectors for kitchen hood exhaust systems shall be slip joint type with high temperature resilient packing material.

END OF SECTION

SECTION 23 0593
BALANCING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all labor, materials and equipment required to test and balance the mechanical systems identified on the contract drawings and these specifications, including but not limited to:

1. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.

2. Measurement of final operating condition of HVAC systems.

3. Sound measurement of equipment operating conditions.

4. Vibration measurement of equipment operating conditions.

5. Adjustment of the mechanical systems shall include but not limited to impellers trimmed, new sheeves and belts to match cfm required, etc. as required to match equipment specified.

6. Operating Test

1.3 RELATED SECTIONS

23 0000	HEATING, VENTILATING, AND AIR CONDITIONING INDEX
23 0100	DEMONSTRATION AND TRAINING
23 0500	GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS
23 3000	AIR DISTRIBUTION
25 1100	ELECTRICAL CONTROLS AND INTERLOCKS
25 3000	CONTROLS AND INSTRUMENTATION

1.4 REFERENCES

A. The publications listed below form a part of these specifications to the extent referenced. Each publication shall be the latest edition of each except as noted.

1. AABC - National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning System.

2. ADC - Test Code for Grilles, Registers, and Diffusers.

3. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

4. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

5. NFPA – NFPA 90A - Installation of Air Conditioning and Ventilating System.

6. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.5 SUBMITTALS

A. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

B. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

C. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

D. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

E. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.

F. Test Reports: Indicate data on AABC National Standards for Total System Balance forms.

G. When test and balancing has been completed, the balancing agency shall prepare a complete report including design and test conditions compared. The report shall be as outlined below.

H. Seven copies of the complete and compiled test data shall be submitted to the Contractor for forwarding to the Architect/Engineer for evaluation and approval.

1. The Report shall be on standard 8-1/2” x 11” good quality paper and bound together to form a complete report. All forms shall be typewritten. Field data may be handwritten on appropriate printed or typewritten forms. Copies of handwritten field notes shall be legible.

2. Each sheet shall have the Building number, name of the Testing Firm, instruments used to perform the tests, name of personnel performing the test, and date test was performed. Date and firm performing the calibration on photometry equipment shall also be included.

3. Outside weather conditions shall be noted during the times the tests were made; cloud cover, temperature, wind speed and direction, precipitation, etc.

I. The Report shall have a T & B Summary section including:

1. Identification of any system or equipment item the Contractor had difficulty balancing to specification or could not be balanced to specification.

2. Identification of any piece of equipment or system whose balance should be rechecked and/or reset during weather conditions different from those present during system balancing.

1.6 PROJECT RECORD DOCUMENTS

A. Record actual locations of flow measuring stations balancing valves and rough setting. Show locations on Test and Balance report reduced size plan drawings.

1.7 QUALITY ASSURANCE

A. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Balancing, and Adjusting of Environmental Systems.

1.8 QUALIFICATIONS

A. The balancing shall be performed by Energy Balance, Inc., Advanced Air Flow Technology, or CloverLEAF. Qualified personnel are limited to registered mechanical Engineers and agencies regularly engaged in testing and balancing work. The Contractor shall submit, prior to the start of the balancing work, the qualifications and experience record of the balancing personnel for approval by the Architect/Engineer.

B. Perform Work under supervision of registered Professional Engineer experienced in performance of this Work and licensed in the state where the Project is located.

C. The balancing agency shall not be associated with or the same contractor furnishing the controls or instrumentation.

1.9 PRE-BALANCING CONFERENCE

A. Convene pre-balancing conference one week prior to commencing work of this section in coordination with Architect/Engineer/General Contractor and his Subcontractors.

1.10 SEQUENCING

A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project. See section 3.1 for pre-balancing inspection.

PART 2 - PRODUCT

2.1 INSTRUMENTS

A. Instruments in general shall be direct reading. Pressures between 2" W.G. and 12" W.G. shall be measured with manometers. Duct velocities above 600 fpm shall be measured with a pitot tube. Averaging hoods with tight seal shall be used for airflow measurement at diffusers, registers and grilles. RPM shall be measured with a revolution counter and stopwatch. Mercury thermometers are preferred; bi-metallic thermometers may be used if calibration is checked daily. Test report shall list all instruments used and include accuracy and date calibrated. The Contractor shall provide all instruments to make the tests herein specified and required for complete system balancing.

2.2 AIR HANDLERS

A. After the air system is balanced and an optimum fan speed is selected, the adjustable sheaf or sheaves furnished shall be replaced by the Mechanical Contractor with new non-adjustable sheaves for permanent operation.

2.3 PUMPS

A. After the water system is balanced and an optimum pump operating point is selected, the pump impeller shall be trimmed to supply the required capacity for pumps over 2 HP, without throttling the flow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The test and balance agency shall review the plans and specifications prior to installation of the system and submit a report to the Architect/Engineer of any deficiencies in the system which could preclude proper adjusting, balancing and testing of the system.

B. The test and balance agency shall inspect the system prior to adjusting, balancing, and testing work to ensure that all specified components which will affect proper execution of such work are installed and are operating properly. A report shall be submitted to the Architect/Engineer indicating the results of the inspection within three days of the inspection. The following is a partial list of items to be inspected and report provided to the Architect/Engineer.

1. Obtain copies of satisfactorily reviewed shop drawings of all air handling equipment, outlets (supply, return, and exhaust), and temperature control diagrams.

2. Compare design to installed equipment and field installations.

3. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

4. Check all dampers for correct and locked position, and temperature control for completeness of installation before starting fans. Dampers shall include, but not be limited to, balancing, control, fire, and smoke.

5. Systems are started and operating in a safe and normal condition.

6. Temperature control systems and control systems are installed complete and operable.

7. Proper thermal overload protection is in place for electrical equipment.

8. Final filters are clean and in place. If required, install temporary media in addition to final filters.

9. Duct systems are clean of debris.

10. Fans are rotating correctly.

11. Fire/smoke and volume dampers are in place and open. The smoke detectors and power to them is installed and the dampers are operational. Air coil fins are cleaned and combed.

12. Access doors are closed and duct end caps are in place.

13. Air outlets are installed and connected.

14. Duct system leakage is minimized.

15. Hydronic systems are flushed, filled, and vented.

16. Proper strainer baskets are clean and in place.

17. Service and balance valves are open.

C. Submit field reports in a timely manner within one week of pre-balancing conference. Report defects and deficiencies noted during performance of services which prevent system balance.

D. Beginning of work means acceptance of existing conditions of the installed system and equipment on the project.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.6 SOUND LEVEL MEASUREMENT PROCEDURE

A. Sound Measurement Equipment Requirements:

1. Sound pressure meter with an Octave Band Analyzer that meets IEC 651 TYPE1 and ANSI S1.4 1983, TYPE1. Include calibrator, compatible microphone, wind screen, and dB(A) scale.
   a) Accuracy: ± 1% of band tested
   b) Calibration: verify with calibrator before testing each project

B. Record a set of background measurements in dB(A) and eight unweighted octave bands (63 Hz to 8,000 Hz) with HVAC system or fan in question off. Background readings shall be taken according to the specifications.

C. Take sound readings in dB(A) and eight unweighted octave hands (63 Hz to 8,000 Hz) with the equipment on. Take readings no closer than three feet from a wall or from the operating equipment and approximately five feet above the finished floor, and only in areas specified. If areas are not specified, then take readings in room adjacent to the mechanical rooms and in any area where the system or air distribution creates noticeable sound levels.

D. Noise levels cannot be averaged by adding and dividing by number of measurements. See the ASHRAE Handbook of Fundamentals for sound calculations.

E. When taking sound measurements, make certain no unrelated personnel are in the room or space. Voices and activity will interfere with the actual noise level readings.

F. Reporting:

1. Calibrate sound test equipment before taking measurements.

2. Record complete test data on the octave band and dB(A)-approved sound test forms.

3. Record the background test on the same form and note conditions at the time of test.

4. Compare test data with noise criteria curves and note if levels are acceptable

5. Note possible causes of any observed excessive noise levels.

6. Where possible, trace the excessive noise level octave band to the source of the noise and comment in the report.

7. Test sound levels at the quietest background noise period. Note any cause of unpreventable sound that will affect the test outcome.

8. For sound entries, include the following:
   a) Area or location,
   b) Sound level in dB(A),
   c) Sound level at the center band frequencies of eight weighted octaves with equipment on and off, and
   d) Plot corrected sound-level reading on Noise Criteria curve, if specified.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

1. Air Cooled Refrigerant Condensers

2. Packaged Roof Top Heating/Cooling Units

3. Packaged Terminal Air Conditioning Units

4. Unit Air Conditioners

5. Computer Room Air Conditioning Units

6. Air Coils

7. Terminal Heat Transfer Units

8. Induction Units

9. Air Handling Units

10. Fans

11. Air Filters

12. Air Terminal Units

13. Air Inlets and Outlets

B. Report Forms

1. Title Page
   a) Name of Testing, Adjusting, and Balancing Agency
   b) Address of Testing, Adjusting, and Balancing Agency
   c) Telephone number of Testing, Adjusting, and Balancing Agency
   d) Project name
   e) Project location

f) Project Architect
g) Project Engineer
h) Project Contractor
i) Project altitude
j) Report date

2. Summary Comments
   a) Design versus final performance
   b) Notable characteristics of system
   c) Description of systems operation sequence
   d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
   e) Nomenclature used throughout report
   f) Test conditions, including weather conditions

3. Instrument List:
   a) Instrument
   b) Manufacturer
   c) Model number
   d) Serial number
   e) Range
   f) Calibration date

4. Electric Motors:
   a) Manufacturer
   b) Model/Frame
   c) HP/BHP
   d) Phase, voltage, amperage; nameplate, actual, no load
   e) RPM
   f) Service factor
   g) Starter size, rating, heater elements
   h) Sheave Make/Size/Bore

5. V-Belt Drive:
   a) Identification/location
   b) Required driven RPM
   c) Driven sheave, diameter and RPM
   d) Belt, size and quantity
   e) Motor sheave diameter and RPM
   f) Center to center distance, maximum, minimum, and actual

6. Pump Data:
   a) Identification/number
   b) Manufacturer
   c) Size/model
   d) Impeller
   e) Service
   f) Design flow rate, pressure drop, BHP
   g) Actual flow rate, pressure drop, BHP
   h) Discharge pressure
   i) Suction pressure
   j) Total operating head pressure

k) Shut off, discharge and suction pressures
l) Shut off, total head pressure

7. Gas Fired Equipment
   a) Manufacturer
   b) Model number
   c) Serial number
   d) Firing rate
   e) Overfire draft
   f) BTUH at sea level
   g) BTUH at altitude
   h) Gas pressure at meter outlet
   i) Gas flow rate in cfh
   j) Heat input
   k) Burner manifold gas pressure
   l) Orifice size
   m) Air temperature rise for gas fired equipment
   n) Check all limit devices for proper operation, setting and calibration
   o) Working pressure
   p) Ambient temperature
   q) Relief valve setting
   r) Static pressure
   s) Heat output

8. Air Cooled Condenser:
   a) Identification/number
   b) Location
   c) Manufacturer
   d) Model number
   e) Serial number
   f) Entering DB air temperature, design and actual
   g) Leaving DB air temperature, design and actual
   h) Number of compressors

9. Electric Duct Heater:
   a) Manufacturer
   b) Identification/number
   c) Location
   d) Model number
   e) Design kW
   f) Number of stages
   g) Phase, voltage, amperage
   h) Test voltage (each phase)
   i) Test amperage (each phase)
   j) Air flow, specified and actual
   k) Temperature rise, specified and actual

10. Induction Unit Data:
    a) Manufacturer
    b) Identification/number
    c) Location
    d) Model number

e) Size
f) Design air flow
g) Design nozzle pressure drop
h) Final nozzle pressure drop
i) Final air flow

11. Air Moving Equipment
a) Location
b) Manufacturer
c) Model number
d) Serial number
e) Arrangement/Class/Discharge
f) Air flow, specified and actual
g) Return air flow, specified and actual
h) Outside air flow, specified and actual
i) Total static pressure (total external), specified and actual
j) Inlet pressure
k) Discharge pressure
l) Sheave Make/Size/Bore
m) Number of Belts/Make/Size
n) Fan RPM

12. Return Air/Outside Air Data:
a) Identification/location
b) Design air flow
c) Actual air flow
d) Design return air flow
e) Actual return air flow
f) Design outside air flow
g) Actual outside air flow
h) Return air temperature
i) Outside air temperature
j) Required mixed air temperature
k) Actual mixed air temperature
l) Design outside/return air ratio
m) Actual outside/return air ratio

13. Exhaust Fan Data:
a) Location
b) Manufacturer
c) Model number
d) Serial number
e) Air flow, specified and actual
f) Total static pressure (total external), specified and actual
g) Inlet pressure
h) Discharge pressure
i) Sheave Make/Size/Bore
j) Number of Belts/Make/Size
k) Fan RPM

14. Duct Traverse:
a) System zone/branch

b) Duct size
c) Area
d) Design velocity
e) Design air flow
f) Test velocity
g) Test air flow
h) Duct static pressure
i) Air temperature
j) Air correction factor

15. Duct Leak Test:
    a) Description of ductwork under test
    b) Duct design operating pressure
    c) Duct design test static pressure
    d) Duct capacity, air flow
    e) Maximum allowable leakage duct capacity times leak factor
    f) Test apparatus
        1) Blower
        2) Orifice, tube size
        3) Orifice size
        4) Calibrated
    g) Test static pressure
    h) Test orifice differential pressure
    i) Leakage

16. Flow Measuring Station:
    a) Identification/number
    b) Location
    c) Size
    d) Manufacturer
    e) Model number
    f) Serial number
    g) Design Flow rate
    h) Design pressure drop
    i) Actual/final pressure drop
    j) Actual/final flow rate
    k) Station calibrated setting

17. Terminal Unit Data:
    a) Manufacturer
    b) Type, constant, variable, single, dual duct
    c) Identification/number
    d) Location
    e) Model number
    f) Size
    g) Minimum static pressure
    h) Minimum design air flow
    i) Maximum design air flow
    j) Maximum actual air flow
    k) Inlet static pressure

18. Air Distribution Test Sheet:
    a) Air terminal number
    b) Room number/location
    c) Terminal type
    d) Terminal size
    e) Area factor
    f) Design velocity
    g) Design air flow
    h) Test (final) velocity
    i) Test (final) air flow
    j) Percent of design air flow

19. Sound Level Report:
    a) Location
    b) Octave bands - equipment off
    c) Octave bands - equipment on

20. Vibration Test (all equipment based on equipment type):
    a) Location of points:
        1) Fan bearing, drive end
        2) Fan bearing, opposite end
        3) Motor bearing, center (if applicable)
        4) Motor bearing, drive end
        5) Motor bearing, opposite end
        6) Casing (bottom or top)
        7) Duct after flexible connection (discharge)
        8) Duct after flexible connection (suction)
    b) Test readings:
        1) Horizontal, velocity and displacement
        2) Vertical, velocity and displacement
        3) Axial, velocity and displacement
    c) Normally acceptable readings, velocity and acceleration
    d) Unusual conditions at time of test
    e) Vibration source (if non-complying)

3.8 CALCULATIONS

A. The following calculations shall be made and become part of the reported data.

1. The CFM at each heating, cooling, and fan coil, the heating and/or cooling capacity of each and the air temperature change of each.

2. The fuel flow to each gas fired unit and the BTUH input.

3. The capacity of each refrigeration unit in BTUH or tons at full capacity and at each unloaded step.

3.9 OPERATING TEST

A. The test and balance agency shall coordinate and set up an operating test when Test & Balance is completed to ensure complete operation of the system in all

modes. The controls contractor, sheet metal trade and the general contractor shall certify in writing test completion and all units are operating as designed. Attach copy of operating test to Test & Balance report.

END OF SECTION

SECTION 23 1126
LIQUID PETROLEUM GAS SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to work of this section.

B. Division 2 – Trenching and Backfilling section is included as work under this section.

C. Division 23 Related Sections.

1.2 DESCRIPTION OF WORK

A. Extent of Liquid Petroleum Gas System (LPG) work is indicated on drawings and schedules, and by requirements of this section. Obtain all permits as required by State in which work is completed and pay all fees and costs. All underground components of the system shall be polyethylene and shall be fully compatible for fusion welding.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of gas system products, of types, materials, and sizes required, whose products have been satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with gas systems work similar to that required for this project and licensed for gas installation in the state of where the project is located. Provide certification that the individual installer(s) have been trained in, and have passed the manufacturer's qualification procedures for the welding and installation of the polyethylene pipe, fittings, and valves to be installed on this project.

C. Personnel responsible for making heat fusion bonded joints in plastic piping shall be certified in accordance with CFR Title 49, Part 192, Section 192.285. Additionally, personnel shall be trained by electrofusion equipment manufacturer or by manufacturer's authorized representatives.

D. The entire installation shall be fabricated and installed in accordance with the latest edition of the following Codes and Standards:

1. ASME B16. Standards for Pipes and Fittings

2. ASME B1.20.1: American conical pipe thread ACC. ANSI/ASME B1.20.1 - 1983 inside thread conical, outside thread conical

3. ASTM Compliance: All polyethylene piping, tubing, fittings, and valves shall comply with:
   a) ASTM D1248: Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
   b) ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials for P.E.
   c) ASTM D2306: Standard Test Method for C 8 Aromatic Hydrocarbon Analysis by Gas Chromatography
   d) ASTM D2406: Method of Testing Flexible Cellular Materials-Molded Urethane Foam
   e) ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

4. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded or Seamless

5. ASTM A106: Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

6. ASTM D2513: Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

7. ANSI B31.2: “Fuel Gas Piping”

8. CFR Title 49, Part 190: Pipeline Safety Programs and Rulemaking Procedures

9. CFR Title 49, Part 191: Transportation of natural and other gas by pipeline; annual reports, incident reports, and safety-related condition reports

10. CFR Title 49, Part 192, Section 192.285: Transportation of Natural and Other Gas by Pipeline Minimum Safety Standards

11. DOT Compliance: Installation shall comply with DOT Guidance Manual for Operation of Small Gas Systems.

12. NFPA 54: “National Fuel Gas Code”

13. NFPA 58: “Standard for the Storage and Handling of Liquefied Petroleum Gases”

14. NAPCA 12-78-94: External Application Procedures for Plant Applied Fusion Bonded Epoxy (FBE) Coatings to Steel Pipe

15. NAPCA 14-83-94: External Application Procedures for Polyolefin Pipe Coating Applied by the Cross Head Extrusion Method or the Side Extrusion Method to Steel Pipe

16. NAPCA 15-83-94: External Application Procedures for Plant Applied Tape Coating to Steel Pipe

17. Uniform Plumbing Code (UPC)

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with NFPA 54 where applicable. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in the gas system. Where more than one type of materials or products are indicated, selection is Installer's option, but shall comply with these specifications and all applicable codes.

2.2 PIPE

A. Underground distribution 10 psig pipe, tube and fittings shall be 2306/2406 polyethylene meeting the requirements of ASTM D1248 and D3350 for P.E. 2306/2406 and the appropriate requirements of ASTM D2513 and ASTM D2837.

B. Gas Service and Liquid Piping above grade – exterior to and from tank and before vaporizer.

1. All pipe sizes: Black steel pipe; ASTM A53 or A106 Schedule 80; wrought steel buttwelding fittings.

2.3 VALVES

A. Above ground valves1-1/2" and smaller shall be Rockwell-Nordstrom No. 142 lubricated plug valve with lubricant for LPG gas service or approved equal. 2" and larger, Rockwell-Nordstrom No. 143 lubricated plug valve with lubricant plug valve No. 555 lubricated for LPG service or approved equal.

2.4 PIPING SPECIALTIES

A. Flexible Connector: NFPA 58, corrugated stainless steel inner hose, stainless steel cover, 350 psig working pressure. Approved for LP gas service.

B. Transition Riser: Anodeless type polyethylene carrier pipe, fusion-bonded epoxy coated steel jacket pipe, threaded aboveground end. Sized to match connecting piping. Horizontal and vertical leg dimensions to meet depth-of-cover requirements. ASR by Uponer Aldyl Co., Shawnee, OK, or approved equal.

C. Strianer: Wye pattern, full line size, threaded ends, designed for LP gas service, 600 psig working pressure. Removable 80 mesh stainless steel screen and

access flange with O-ring gasket. Type W, as manufactured by Smith Precision Products Company, Newberrt Park, CA, or approved equal.

2.5 SLEEVES

A. Schedule 40 black steel pipe with inside edge reamed smooth. Underground sleeves shall be protected against corrosion by a coal tar or asphalt coating.

2.6 TRANSITION FITTINGS

A. Pre-manufactured plastic covered threaded transition fittings shall be installed where connection to existing steel pipe is made. Each transition fitting shall be provided with a five pound cathodic protection anode connected. Transition fittings shall be installed with a strap wrench to prevent damage to the coating. Fittings with damaged coating will be replaced. Clean, coat, and wrap connection between existing steel pipe and the transition fitting to result in a continuous protective coating for pipe to fitting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Where gas lines are indicated to be sleeved below walks and rise at building, install in accordance with industry standard GAS sleeve details; vent all such sleeves to the out-of-doors.

B. All welding shall be performed using established welding procedures by welders who have been certified for the welding procedure to be used in accordance with Title 49 – Transportation Code of Federal Regulations, Parts 190, 191, and 192.

C. Polyethylene pipe, tubing and fittings shall be installed and welded by certified welders in strict conformance with the manufacturer’s recommendations and all code requirements.

D. Union, plug cock, and drip leg with removable cap is required at all points of use.

E. Support all above grade piping, regulators, etc, on pipe stands mounted in concrete to keep load off the connecting pipe.

F. Exterior below grade piping shall be protected by minimum of 30 inches earth cover. Pipe running under roads shall be provided with schedule 40 black steel sleeve which will provide at least 1-1/2” clearance all around the pipe. A continuous two inch wide warning tape shall be buried one foot below grade directly over the gas line and a continuous trace wire shall be run along the pipe. Trenching and backfilling shall comply with Division 2 – Sitework.

G. Piping exposed to the weather will receive two coats (brushed) coal tar varnish.

H. Valve boxes shall be set on concrete base with no weight bearing on the pipe.

I. Protect tanks from corrosion and vehicle damage. Install bollards 4-feet on center all around tank, vaporizer and fill station.

3.2 SUBMITTALS

A. Submit manufacturer's data and certifications on all piping, tubing, fittings, valves, valve boxes, and anodeless risers, that are to be installed in GAS system complete. The submittal shall contain a complete detailed schematic drawing of the tank installation, tank support, (reviewed and stamped by Structural Engineer) and fuel transfer station with support details. Clearly identify all components (excess flow valves, pressure reducing valves, pipe sizes, etc). Submit complete manufacturer's recommendations, requirements, procedures, temperatures (welding) for the fusion welding of the polyethylene pipe, tubing, fittings, and valves. Submit a copy of the installing company's current gas license and copies of individual installer's certificate that they have passed the manufacturer's qualification procedures for the welding and installation of polyethylene pipe, fittings, and valves to be installed on this project. Submittal of all GAS system components, schematic drawings, manufacturer's data, fusion welding procedures, etc, shall be made at one time as a package; partial submittals will not be accepted.

3.3 TESTING

A. Test GAS system with 60 psi air pressure and hold for four (4) hours. Purge tank and piping of air in accordance with NFPA 54 and 58. Purge tank four (4) times in accordance with REGO LPG Serviceman's manual to achieve no more than 6.25% air remaining in tank.

3.4 FUEL SUPPLY

A. The Contractor shall provide all GAS required heating, operating, construction use and testing of the system until the time the Owner takes beneficial occupancy or gives final acceptance (whichever comes first) of the project.

3.5 CLOSEOUT SUBMITTALS

A. As specified in Division 1 and 23.

B. Operation and Maintenance data as required by Division 1 and 23.

1. Submit operation and maintenance data for the following:
   a) Valves
   b) Regulators
   c) Tank appurtenances
   d) All piping
   e) Pipe manufacture installer Certifications

C. Test Reports

3.6 FIELD QUALITY CONTROL

A. Inspect, test, and purge gas system in accordance with NFPA 54 and NFPA 58. Test with air or inert gas only.

B. Test at pressure of 60 psi for a period of not less than four (4) hours without showing any drop in pressure.

C. Check connections with a leak test solution, which is listed for this purpose. So not use soap solution or solutions containing ammonia, which made corrode the pipe.

D. Repair leaks and defects with new materials. Makeshift remedies will not be permitted. Retest system until satisfactory results are obtained.

E. Submit written test report to Architect/Engineer for review.

F. Verify capacities and pressure ratings of gas meters, regulators, valves and specialties.

G. After pressure testing has been completed, fully purge all air from gas piping. No not purge open end of piping systems into confined spaces or areas where there are sources of ignition, unless the space is adequately ventilated, purging rate is controlled, and all hazardous conditions are eliminated.

END OF SECTION

SECTION 23 3000
AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install fans, filters, sheet metal work, grilles, louvers, diffusers, registers, sound traps, special fan bases, fire dampers, combination fire and smoke dampers and sleeves, accessories and natural gas fired appliance flue vents.

B. All automatically controlled dampers furnished under Section 25 3000 - CONTROLS AND INSTRUMENTATION will be installed under this section. After dampers are set, they shall be balanced for free and easy operation.

C. Where ductwork has an interior lining, dimensions shown on drawings shall be clear dimensions inside the liner.

D. Prior to system test and balance, supply and install new, clean air filters throughout the air handling systems except for any high efficiency filters, which have pressure drop within normal operating limits.

1.3 REQUIREMENTS AND RELATED WORK

23 0000	HEATING, VENTILATING, AND AIR CONDITIONING INDEX
23 0500	GENERAL HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS
23 0593	BALANCING OF MECHANICAL SYSTEMS
25 3000	CONTROLS AND INSTRUMENTATION

1.4 REFERENCES

A. ASTM A36 – Structural Steel

B. ASTM A90 – Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

C. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

D. ASTM A366 – Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

E. ASTM A480 – General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

F. ASTM A525 – General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process

G. ASTM A527 – Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality

H. ASTM A568 – Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled

I. ASTM A569 – Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

J. ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate

K. AWS D9.1 – Welding of Sheet Metal

L. NFPA 90A – Installation of Air Conditioning and Ventilating Systems – Latest Edition

M. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems -Latest Edition.

N. NFPA 91 – Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying - Latest Edition

O. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment - Latest Edition

P. SMACNA – HVAC Air Duct Leakage Test Manual

Q. SMACNA – HVAC Duct Construction Standards - Metal and Flexible - 1985

R. UL STANDARD 181 – Factory-Made Air Ducts and Connectors

S. UL STANDARD 555 – Standard for Safety Fire Dampers

T. UL STANDARD 555S – Leakage Rated Dampers for use in Smoke Control Systems

PART 2 - PRODUCTS

2.1 EQUIPMENT SCHEDULES

A. All major items of equipment are specified in the equipment schedule on the drawings and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory operating system.

B. All registers, grilles and diffusers shall be as listed in the schedule on the drawings. Frame style shall be coordinated by the Contractor to match the ceiling type shown on the reflected ceiling plans of the Contract Documents.

2.2 DUCTWORK

A. Sheet Metal

1. Materials and Gauges: Construct all ducts, casings, plenums, etc., of galvanized steel sheets, of the gauges specified below, unless otherwise shown. Sheets shall be free from blisters, slivers, pits and imperfectly galvanized spots.

2. All ductwork shall be constructed in accordance with "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE". First Edition, 1985 as published by Sheet Metal and Air Conditioning Contractors National Association, Inc. Pressure class for all ductwork shall be 2” or unless otherwise noted on plans.

3. Construct low velocity ducts using Pittsburgh or "Snap-Lock" corner seams. All seams shall be made airtight. Using United Mc Grill “UNI-FLEX” duct sealer or approved equal.

4. Connections of high pressure and/or velocity ducts, fittings and high pressure boxes shall be made airtight by tack welding on 8" centers and coating joints with United Mc Grill “United duct Sealer”.

5. Round ducts and fittings for high velocity systems shall be spiral lock seam conduit as manufactured by United Mc Grill Co., Inc., or approved equal. All 90 elbows shall be at least 5-piece construction. Standard manufactured ducts of other than spiral construction will be acceptable if constructed of the following gauges with welded seams. Sizes through 12-inch diameter shall be 22-gauge, 13-inch through 36-inch diameter shall be 20 gauge, 37 inches and over shall be 18-gauge. Basic high velocity fittings are detailed on the drawings. Spun or tapered takeoffs shall be used from all vertical high velocity risers.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 time’s width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible, maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45-degree lateral wye takeoffs unless otherwise indicated where 90-degree conical tee connections may be used.

F. Flexible

1. Flexible ducts for connections between rigid ductwork and variable volume boxes shall be Factory Insulated flexible conduit capable of holding 5 inches W.C. without development leaks and shall not exceed a flame spread of 25 or a smoke development of 50. Thermo flex Type N-KH or approved equal.

2. Flexible connections between the diffusers and the run out ducts shall be factory insulated, sound absorbing low velocity flexible conduit conforming to the following duct fabrication shall not exceed a flame spread of 25 or a smoke development of 50.
   a) Two ply vinyl film supported by helically wound spring steel wire: fiberglass insulation: polyethylene vapor barrier film.
   b) Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
   c) Maximum Velocity: 4000 fpm (20.3 m/sec).
   d) Temperature Range: -10 degrees F to 160 degrees F (-23 degrees C to 71 degrees C).

2.3 COMBINATION FIRE/SMOKE DAMPERS

A. Furnish and install at locations shown on plans, or as required by code combination fire/smoke dampers meeting the following specifications. Frame shall be galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.

B. Each combination fire smoke damper shall be 1-1/2 hour fire rated under UL Standard 555 or greater where noted on architectural plans, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. The leakage rating under UL555S shall be Leakage Class II (10 cfm/ft. at 1” w.g.)

C. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250º F, 350ºF, or 450ºF depending upon the actuator. Appropriate electric “Firestat” operator shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Manufacturer shall provide factory assembled sleeve of 16” minimum length (contractor to verify requirement). Factory supplied caulked sleeve shall be 16 gage for dampers up to 36” wide by 24” tall and 14 gage above 36” wide X 24” tall.

1. Combination Fire/Smoke dampers shall be Ruskin FSD6O rectangular dampers and Ruskin FSDR25 for round dampers or approved equal with correct mounting frames and sleeves for actual installation.

2. Combination Fire/Smoke dampers for corridors ceiling shall be Ruskin FSD36 with internally mounted actuator.

D. Each combination fire and smoke damper shall include an integral factory furnished and installed duct smoke detector compatible with the building fire alarm system. Assembly by Ruskin DSDN or approved equal.

E. Size of access doors in ductwork shall be 2 inches less than the width of the duct by 12 inches, up to a maximum size of 24 inches by 24 inches.

2.4 FIRE DAMPERS

A. Furnish and install at locations shown on the drawings or as required by code fire dampers meeting the following requirements. Provide access doors at all fire damper locations of sufficient size to allow easy resetting of fire damper linkage. Fire damper links shall be of the test strength recommended to prevent nuisance closing. All fire dampers shall conform to the requirements of NFPA Pamphlet 90A and shall meet the required UL Standard 555.

B. High Velocity Round or Oval Fire Dampers: High velocity fire dampers shall be of the folding blade type designed for minimum static pressure drop. Fusible links shall be accessible from either side of the damper. Each damper shall be furnished complete with a galvanized welded steel sleeve (round or oval) and closure compartment to house the folded blades. Fire dampers shall be Ruskin FD35 with 165°F fusible link or approved equal.

C. Rectangular Fire Dampers: Fire dampers for rectangular ductwork shall be of the folding blade type with the hinged blades completely out of the air stream of the single hinged blade type. Fusible links shall be accessible from either side of the damper. Each damper shall have a galvanized welded steel sleeve (rectangular or square) and closure compartment to house the folded blades. Rectangular fire dampers mounted in the horizontal plane are to be spring loaded. Fire dampers shall be Ruskin DIBD with 165°F fusible link or approved equal.

D. Provide access doors at all fire damper locations of sufficient size to allow easy resetting of fire damper linkage. Size of access doors in ductwork shall be 2 inches less than the width of the duct by 12 inches, up to a maximum size of 24 inches by 24 inches.

E. Each fire damper shall be provided with spare fusible link(s) secured to the damper.

2.5 ACCESS DOORS

A. Wall and Ceiling Access Doors: Furnish as required in Section 230500, paragraph 3.6.

B. Duct Access Doors: Duct access doors at fire dampers and other locations which require access to mechanical devices inside of ductwork shall be Controlair 16-gauge access door with continuous hinge, neoprene gasket, thumb screw locks and baked enamel finish. Doors shall be sized for easy access to mechanical device.

2.6 FILTERS

A. Filters shall be as listed in the schedule on the drawings.

B. Filter gauge for each bank of filters in the mechanical rooms and roof top equipment will be supplied and installed by the Controls Contractor as specified in Section 253000 - CONTROLS AND INSTRUMENTATION.

2.7 COILS

A. In no case shall specified air or water pressure drops be exceeded more than 10%. Piping connections shall be as shown on the drawings. Coils shall be as specified in the equipment schedule on the drawings. In no case shall rows or fin spacing be less than the minimum surface scheduled.

2.8 TURNING VANES

A. Turning vanes shall be installed in all square elbows. Turning Vanes shall be air foil blade type, shop or factory fabricated.

2.9 FLUE GAS VENTS

A. Gas fired equipment shall be vented in accordance with the Uniform Mechanical Code, Uniform Plumbing Code and local codes and ordinances.

1. Natural draft appliances shall have Type “B” vents.

2. Forced draft appliances shall have Metalbestos Type PS, 16-gauge black steel vents.

3. Condensing boilers shall be double wall stainless steel, constructed in modular sections by Jeremias DWGV or approved equal, and shall be UL listed under UL 1738, approved type 444, 316L, or AL29-4C for interior liner, and type 304 stainless steel outer jacket.

PART 3 - EXECUTION

3.1 INSTALLATION OF SHEET METAL WORK

A. All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary the required area shall be maintained. All of these changes, however, must be approved and installed as directed at the project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering. Whenever exposed ducts pass through walls, floors or ceilings, a flanged sheet metal collar fitting close around ducts shall be slipped along duct until flange is tight against finished surface covering edges of openings and presenting a neat appearance. Collar shall be locked to duct.

B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

C. Use double nuts and lock washers on threaded rod supports.

D. Connect diffusers or light troffer boots to low-pressure ducts with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.

E. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

F. All ducts, coils, housings, registers, grilles, fans, etc., shall be clean when installed and shall be kept clean until the system is completed. As the various parts of the system are installed, they shall be wiped or blown clean and openings taped dust-tight with heavy paper or cardboard until the system is completed and ready for testing. At that time all covers and protective wrappings shall be removed. Where one has been torn or previously removed, the duct, coil, register, etc., shall be carefully cleaned of any dirt or dust that has entered the opening.

3.2 DUCTS AT MASONRY

A. Where ducts are shown connecting to masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2" x 1/8" galvanized angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron.

3.3 HAND AND SPLITTER DAMPERS

A. Install hand operated volume and splitter dampers at all locations of branches of main ducts, from equipment, supply ducts, return ducts and at all locations where air flow splits or is balanced, whether shown or not. Volume dampers shall be controlled by heavy duty locking quadrants mounted on the outside of the duct. Where ducts are insulated, the damper rod shall be extended and the operator shall be mounted on the outside of the insulation. Where volume dampers are installed in ducts over 12" deep, the dampers shall be made in two sections and each independently operated. Splitter dampers shall be at least 1 1/2 times as long as the narrowest adjacent split. All damper fittings must be heavy commercial items and must be approved by the Architect/Engineer before installation.

3.4 FLEXIBLE CONNECTIONS

A. Provide glass fabric, neoprene coated flexible connections, not less than 6" wide at the inlet and outlet connection of each fan unit, securely fastened to the unit and to the ductwork. Material shall comply with Underwriter's Laboratories Standard 214.

B. Indoor applications shall have Metaledge Ventglas with heavy glass fabric, double coated with Dupont's Neoprene.

C. Outdoor applications shall have Metaledge Ventlon with heavy glass fabric, double coated with Dupont's Hypalon.

3.5 CROSS BREAKING

A. Rectangular sheet metal ducts shall be cross-broken on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross-broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of the cross break shall be of the required height to assure surfaces being rigid. High velocity plenum panels and ductwork shall not be cross-broken.

3.6 TEST HOLES IN DUCTWORK

A. Furnish test holes in ducts at locations required by the testing and balancing team for testing of air quantities in ducts. Ventlok No. 699, closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

3.7 HANGERS AND SUPPORTS

A. Hangers for ducts up to 18 inches in width or diameter shall be placed not more than ten-foot centers. Ducts 19 inches and over in width or diameter shall be supported on not more than five foot centers. Hangers shall be placed plumb and present for a neat appearance. Construct hangers for high velocity boxes and for ductwork form galvanized iron 1" x 1" x 1/16" for ducts up to 36 inches in width or diameter. For ducts over 36 inches in width or diameter, support ducts every 4'-0" with 1 1/4" x 1 1/2" x 1/8" angles. The use of perforated band iron for duct support is prohibited. Hangers shall extend down the sides of the ducts using not less than three rivets or parker screws of appropriate sizes. It is essential that all ducts be rigidly supported. Where vertical ducts pass through floors or roofs heavy supporting angles shall be attached to ducts and to the structure. Angles shall be of sufficient size to support ductwork rigidly. Place supporting angles on at least two sides of the duct.

3.8 FABRICATION

A. All ductwork shall be fabricated with the mill markings on the outside.

3.9 TESTS

A. Testing and balancing of the air tempering systems will be as specified in Section 23 0593 - BALANCING OF MECHANICAL SYSTEMS.

B. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor shall make any changes necessary to provide the specified conditions.

C. Cleaning ducts and testing for tightness: Before the ceiling is installed and final connections are made to air outlet devices, operate the fans at full capacity to

blow out dirt and debris from the ducts. If it is not practical to use the main supply blower for cleaning, the ducts may be blown out in sections by a portable fan. After the ducts have been cleaned, an air tightness test shall be made on all ductwork. A minimum pressure equal to fan static pressure at less than 10% of design flow or 2 1/2 times design external static pressure, whichever is less shall be maintained during the test. A soap test shall be applied to all sheet metal connections and joints to locate air leaks. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away), shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. In lieu of the above tightness tests, the Contractor may test the ducts by attaching a fan with a capacity of not over 300 cfm at 2 1/2" static pressure to the ductwork and with outlets blocked air tight, build up the pressure in the ducts to 2" water gauge. If this pressure cannot be obtained the Contractor shall locate and repair the leaks as specified above. The Architect/Engineer and Owner's Representative shall witness the test and the Contractor shall notify the Insulation Contractor in writing when the test has been satisfactorily completed.

END OF SECTION

SECTION 23 3113
DUCTWORK CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 RELATED WORK IN OTHER SECTIONS

23 0000 HEATING, VENTILATING, AND AIR CONDITIONING INDEX
23 0500 GENERAL HEATING, VENTILATING, AND AIR CONDITIONING REQUIREMENTS

PART 2 - SPECIAL PROVISIONS

2.1 QUALIFICATION OF THE HVAC SYSTEM CLEANING CONTRACTOR

A. Membership: The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.

B. Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

C. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.

D. Experience: The HVAC system cleaning contractor shall submit records of experience in the field of HVAC system cleaning as requested by the owner. Bids shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

E. Equipment, Materials and Labor: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.

1. The contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., contractors should comply with applicable national safety codes and standards.

2. The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification Contractor shall submit to the owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.

F. Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

2.2 STANDARDS

A. NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.

2. NADCA Standards must be followed with no modifications or deviations being allowed.

2.3 DOCUMENTS

A. Mechanical Drawings: The owner shall provide the HVAC system cleaning contractor with one copy of the following documents:

1. Project drawings and specifications.

2. Approved construction revisions pertaining to the HVAC system.

3. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

PART 3 - HVAC SYSTEM CLEANING SPECIFICATIONS AND REQUIREMENTS

3.1 SCOPE OF WORK

A. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

1. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

2. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This

includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

a) Note: Users of this specification must modify the above paragraph to succinctly and specifically define those systems and components requiring cleaning.

3.2 HVAC SYSTEM COMPONENT INSPECTIONS AND SITE PREPARATIONS

A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected.

1. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented

a) Damaged system components found during the inspection shall be documented and brought to the attention of the owner.

B. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

C. Inspector Qualifications: Qualified personnel should perform the HVAC cleanliness inspection to determine the need for cleaning. At minimum, such personnel should have an understanding of HVAC system design, and experience in utilizing accepted indoor environmental sampling practices, current industry HVAC cleaning procedures, and applicable industry standards.

3.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.

B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron

size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

C. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.

D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

F. Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.

1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.

2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.

3. Closures must not significantly hinder, restrict, or alter the airflow within the system.

4. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.

5. Openings must not compromise the structural integrity of the system.

6. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.

7. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.

8. Rigid fiber glass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181a are suitable for fiber glass duct system closures.

9. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the owner in project report documents.

G. Ceiling sections (tile): The contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.

H. Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.

I. Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The contractor shall insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:

1. Clean all air handling units (AHU) internal surfaces, components and condensate collectors and drains.

2. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.

3. Clean all coils and related components, including evaporator fins.

J. Duct Systems: Contractor shall:

1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.

2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

3.4 HEALTH AND SAFETY

A. Safety Standards: Cleaning contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

C. Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

3.5 MECHANICAL CLEANING METHODOLOGY

A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.

2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.

3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components

1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material

1. Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.

2. Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.

3. Replacement material: In the event fiber glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.
   a) Replacement of damaged insulation is not covered by this specification.

D. Cleaning of coils

1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

E. Biocidal Agents and Coatings

1. Biocidal agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.

2. Application of any biocidal agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.

3. Only biocidal agents registered by the U.S. Environmental Protection Agency (EPA) specifically for use within HVAC system shall be used.

4. Biocidal agents shall be applied in strict accordance with manufacturer's instructions.

5. Biocidal coating products for both porous and non-porous surfaces shall be EPA registered, water soluble solutions with supporting efficacy data and MSDS records.

6. Biocidal coatings shall be applied according to manufacturer's instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces. A continuous film must be achieved on the surface to be treated by the coating application. Application of any biocidal coatings shall be in strict accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

3.6 CLEANLINESS VERIFICATION

A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.

B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.

1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the owner reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.

2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

3. NADCA vacuum test analysis should be performed by a qualified third party experienced in testing of this nature.

4. Cleanliness verification shall be performed immediately after mechanical cleaning and before the HVAC system is restored to normal operation.

C. Verification of Coil Cleaning

1. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

3.7 PRE-EXISTING SYSTEM DAMAGE

A. Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

3.8 POST-PROJECT REPORT

A. At the conclusion of the project, the Contractor shall provide a report to the owner indicating the following:

1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.

2. Areas of the system found to be damaged and/or in need of repair.

3.9 APPLICABLE STANDARDS AND PUBLICATIONS: The following current standards and publications of the issues currently in effect form a part of this specification to the extent indicated by any reference thereto:

A. National Air Duct Cleaners Association (NADCA): "ACR-2002, Assessment, Cleaning & Restoration of HVAC Systems," 2001.

B. National Air Duct Cleaners Association (NADCA): "Understanding Microbial Contamination in HVAC Systems," 1996.

C. National Air Duct Cleaners Association (NADCA): "Introduction to HVAC System Cleaning Services," 2002.

D. National Air Duct Cleaners Association (NADCA): Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems," 1997.

E. Underwriters' Laboratories (UL): UL Standard 181.

F. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-89, "Ventilation for Acceptable Indoor Air Quality".

G. Environmental Protection Agency (EPA): "Building Air Quality," December 1991.

H. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Duct Construction Standards - Metal and Flexible," 1985.

I. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 1993.

END OF SECTION

SECTION 25 0000
INTEGRATED AUTOMATION INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Integrated Automation Work, as indicated on the Drawings and specified herein. Integrated Automation work indicated on the Drawings and/or specifications covering other trades shall conform to Division 25 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Integrated Automation systems shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for Integrated Automation service connections to all the various items of equipment requiring controls service throughout the project shown on the Contract Drawings (even if not shown on Integrated Automation Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 INTEGRATED AUTOMATION DIVISION INDEX

25 1100 ELECTRICAL CONTROLS AND INTERLOCKS
25 3000 CONTROLS AND INSTRUMENTATION

PART 2 – PRODUCTS (Not used.)

PART 3 – EXECUTION (Not used.)

END OF SECTION

SECTION 25 1100
ELECTRICAL CONTROLS AND INTERLOCKS

PART 1 - GENERAL

1.1 Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED WORK IN OTHER SECTIONS

26 0500	GENERAL ELECTRICAL PROVISIONS
26 0519	LOW VOLTAGE CONDUCTORS
26 0526	GROUNDING
26 0533	RACEWAYS, BOXES, AND FITTINGS
26 2726	WIRING DEVICES AND PLATES

1.3 DESCRIPTION OF WORK

A. All disconnect means, motor controllers, electrical controls, protective, and signal devices for equipment furnished under Division 25 of these specifications will be installed and connected as scheduled herein or as otherwise noted on the drawings.

B. Electrical items not shown on the electrical drawings, but which are required for equipment furnished under Division 25 of this specification shall be furnished under this section of the specifications and shall be installed and electrically connected in conformance with Division 26 Specifications.

1.4 SUBMITTALS

A. Submittal data for each individual electrically controlled item of equipment or device furnished under this Division of these specifications shall include complete electrical wiring diagrams, and elementary control diagrams (ladder form) showing all internal and external wiring connections and services. The submittal data shall itemize all electrical characteristics that are of a special nature or critical to the electrical installation or control system. Such equipment and devices will not be considered for approval until these requirements are met. These submittals shall form a part Section 25 0500 requirements and shall be properly coordinated by the Contractor.

B. As soon as possible after contract notice to proceed, one print of the ladder diagrams shall be submitted by the contractor showing all necessary wiring for the mechanical equipment and devices proposed for installation. This print shall be reviewed and approved by the contractor, and then submitted to the Architect/Engineer for approval. The print shall indicate all components which shall be wired to the control/power circuits by the contractor, with all terminals for external connections of the components identified and labeled to correspond to the manufacturer's designations. Internal or factory installed wiring of package-type components need not be shown. Control diagrams shall show all internal and external wiring connection and shall clearly indicate field wiring furnished

and installed under Division 25, differentiated from field wiring furnished and installed under Division 26.

C. Revised Drawings: After the Architect/Engineer has approved the marked copy of the control diagrams submitted in accordance with Paragraph B above, the Contractor shall issue prints to all involved parties. The control diagrams shall be certified in writing as being acceptable to the contractor. The approved drawings will then be included in the control submittal and the Operating and Maintenance Manual.

1.5 INSTALLATION

A. No control work shall be performed until control submittal has been approved by the Architect/Engineer.

1.6 CHANGES DURING CONSTRUCTION

A. The complete responsibility and costs for revisions during construction to the approved control diagrams, and the resultant changes to the installation requirements, not covered by contract change order, shall be assigned to the contractor requesting such revisions.

PART 2 - PRODUCTS

2.1 CONTROL AND INTERPOSING RELAYS

A. Relays other than those on I/O cards shall be general purpose, enclosed plug-in type with 8 pin octal plug and protected by a heat and shock resistant dust cover. Relays shall be of the Neon or LED indicator type.

B. Relay contact configuration and ratings shall be for rated load voltage and exceed load current rating by no less than fifty percent. Minimum contact rating shall be 10 amps at 120 volts AC.

2.2 TERMINAL STRIPS

A. Terminal strips shall be of the molded nylon or polypropylene barrier type, individual plug-in mounted on a mounting channel. Terminal connections shall be rated 300-volt, 40 amp and shall be of the tubular clamp type for use with bare wire ends, or of the strap screw type for use with crimp spade lug prepared wire ends. Terminal strips shall provide for removable marking strips or have prepainted matte finish marking surfaces. Buchanan 600 series or approved substitute.

PART 3 - EXECUTION

3.1 RELAYS

A. All remote field devices shall be controlled through the use of an interposing relay. In no case shall a contactor or motor starter be directly controlled from a solid state device output or relay contact of a rating less than that stated above.

3.2 COMPONENT IDENTIFICATION

A. All individual components (relays, timers, terminal strips, etc.) shall be clearly marked with the identification nomenclature shown on the manufacturer's shop drawings. Identification shall be by the use of press-type tape strip (kroy) covered with Scotch 600 clear tape or approved substitute method.

3.3 CONTROL WIRING INSTALLATION

A. The installation and wiring of all electrical equipment installed under this contract shall meet all Electrical Division specifications. Special attention is called to the following:

1. All wiring to be in conduit.

2. All control wiring to be color-coded throughout. Conductor color shall be consistent for the entire length of circuit.

3. All splices shall be made in junction boxes on terminal strips.

4. All control wiring to terminate on marked terminal strips and shall be marked at all terminal points. Both ends of each wire shall be marked with a designation shown on the manufacturer's shop drawings, using interlocking chevron shaped snap-on plastic markers, hot-marked shrinkable tubing, hot stamping of the wire, or clear shrink-on tubing securing adhesive labels. Markers which depend solely on adhesive are not acceptable.

END OF SECTION

SECTION 25 3000
CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a control system, complete in all respects to provide the Sequence of Control shown on the drawings.

B. All disconnect means, motor controllers, and all protective and signal devices for all electrical equipment provided under all Electrical Divisions will be furnished, installed and connected under all Electrical Divisions with the following exceptions:

1. All controls wiring and conduit for HVAC equipment is the complete responsibility of all Mechanical Divisions. Electrical connections, relays, interlocks, etc. not shown on the electrical drawings, but which are required for equipment furnished under all Mechanical Divisions shall be installed and electrically connected by all Mechanical Divisions in conformance with all Electrical Division Specifications.

2. All disconnect means, motor controllers, and all protective and signal devices furnished with, mounted on and connected integral with equipment furnished under other divisions.

3. All disconnect means, motor controllers, electrical controls, protective, and signal devices for equipment furnished under all Mechanical Divisions of these specifications will be installed and connected as scheduled herein or as otherwise noted on the drawings.

C. The mechanical trade is entirely responsible for furnishing, installing, wiring, connecting and placing the control systems in operation. Electrical work required will be the final responsibility of the Mechanical Contractor either by his own electricians or by his subcontract with an Electrical Contractor.

1.3 RELATED WORK IN OTHER SECTIONS

23 0593	BALANCING OF MECHANICAL SYSTEMS
25 0000	INTEGRATED AUTOMATION INDEX
25 0500	GENERAL INTEGRATED AUTOMATION REQUIREMENTS

1.4 GENERAL REQUIREMENTS

A. The control system shall be furnished complete for the heating and air conditioning systems by Alteron, Invensys (Siebe), Delta, TAC (Andover), and

Honeywell. The temperature control company shall have a permanent, fully staffed, well-established, local office and service organization. A complete stock of all repair and replacement parts for all items furnished under this contract shall be carried in stock at the local office at all times.

B. Submittals: Shall include plan size drawings, with individual literature on each item, showing control sequences, complete electrical ladder diagrams and all control components and their wiring requirements. The Contractor shall be responsible to see that all systems are properly coordinated.

C. Operation and Maintenance Manuals: As soon as possible after Award of Contract, the Contractor shall prepare an Operation and Maintenance (O & M) Manual and submit it to the Engineer for review and approval. The control system testing and training specified hereafter shall not be conducted until the O & M Manual has been approved. See Specification Section 251000 – Direct Digital Control Software and Components. The Manual shall contain, as a minimum:

1. Approved control diagrams.

2. Equipment and device catalog cuts identifying each control device with a unique number or symbol coordinated with the control diagram symbols.

3. A Sequence of Control for each system's control diagram identifying the function and physical location of each adjustable control device, written in language understandable to personnel not specifically trained in HVAC control systems.

4. A Troubleshooting section for each control system indicating what tests and/or adjustments can be made to identify and/or correct common problems with control systems of the type installed. This description should address procedures to determine the cause of high or low space temperature and/or humidity in a typical room served by each air handling system. The description should be adequate to lead untrained persons to conclude, at minimum, whether the unit is receiving adequate primary cooling or heating, whether mixed air and supply air temperatures are reasonable and whether field adjustments or technical service is required to solve the problem. This troubleshooting section shall be bound in a separate section of O & M Manual and shall clearly refer to control device symbols shown on the Control Diagram drawings.

1.5 SPECIAL REQUIREMENTS

A. The controls trade shall check and adjust his control system completely, four (4) times during the warranty period. The fourth (4) check to be made during the final thirty days of the warranty period.

B. The controls trade will furnish the Owner with an accurate, up-to-date wiring diagram of all electrical and electronic equipment installed under this contract.

C. The Contractor shall furnish a complete set of parts lists, operating instructions and maintenance literature, in duplicate, for proper maintenance of all control equipment.

D. Steel lockable covers shall be provided for all space thermostats where shown on the drawings and where the space thermostat could be damaged.

PART 2 - PRODUCTS

2.1 CONTROL AND INTERPOSING RELAYS

A. Relays other than those on I/O cards shall be general purpose, enclosed plug-in type with 8 pin octal plug and protected by a heat and shock resistant dust cover. Relays shall be of the Neon or LED indicator type.

B. Relay contact configuration and ratings shall be for rated load voltage and exceed load current rating by no less than fifty percent. Minimum contact rating shall be 10 amps at 120 volts AC.

2.2 TERMINAL STRIPS

A. Terminal strips shall be individual plug-in type on a mounting channel. Terminal connections shall be rated 300-volt, 40 amp and shall be of the tubular clamp type for use with bare wire ends, or of the strap screw type for use with crimp spade lug prepared wire ends. Buchanan 600 series or approved substitute.

2.3 AUTOMATIC DAMPERS

A. All automatic dampers shall be furnished by the controls trade and shall be constructed of galvanized sheet steel with bushings made of oil impregnated sintered bronze to give constant lubrication. Each damper section shall have positive closing neoprene blade and edge seals. Outside air, return air and relief dampers shall have blades designed so that the blades are interconnected to give parallel movement. Each modulating damper shall provide a near linear relationship between damper opening and airflow. All volume dampers shall have opposed blades, which will produce equal pressure drop flow characteristics. Blade width shall not exceed 6 inches.

2.4 AUTOMATIC CONTROL VALVES - ELECTRIC

A. The controls trade shall provide all automatic control valves and shall be made by the control manufacturer. All electric control valves 2" and smaller in size shall be brass body and trim, 2-1/2" and larger shall be iron body with brass or stainless steel trim. Valves shall be provided with renewable type seats and adjustable springs. Valves shall be designed to pass the quantity of water and with a maximum pressure loss not to exceed 10 ft. Valves shall be provided with "V" port or throttling type seat. Valves 2" or smaller shall be screwed. Valves 2-1/2" and larger shall be flanged. All sequencing valves shall have positive positioners.

2.5 DAMPER MOTORS - ELECTRIC

A. The damper motor shall be electro-hydraulic type capable of providing full proportional control of dampers. The actuator shall be compatible with any low voltage controller or auxiliary device. One motor shall be provided per damper section.

2.6 CONTROL PANELS

A. An enclosed control panel or panels with hinged door and locking device shall be installed where shown on the drawings. Panel layout shall be as shown. Thermometers switches and pilot lights will be flush mounted on the hinged door. Hard tubing shall be brought into the panel. Tubing within the panel may be plastic neatly bundled and tagged. All indicators and controllers will have descriptive bakelite tags.

2.7 FILTER GAUGES

A. Shall be furnished and installed in each filter bank located in the Mechanical Room and at each rooftop air handling unit. Gauges shall be Dwyer Magnahelic with static pressure tips and interconnecting tubing. Range shall be approximately 1-1/2 times the nominal filter change out pressure differential. Each rooftop filter bank shall also have a differential pressure switch with indicator lamp located on a control panel in the Mechanical Room to indicate filter replacement pressure differential has been exceeded.

2.8 SMOKE AND FIRE DETECTORS

A. Smoke detectors shall be furnished and installed in each air handling unit or system and detectors shall be furnished by the Division 26 Contractor, installed by the Division 25 Contractor, connected and tested by the Division 26 Contractor.

2.9 SEQUENCE OF OPERATION

A. The operation of the control system shall be as indicated on the drawings and control diagrams. The sequence shall be rewritten and shown on the control submittal drawing diagramming that system. The sequence on the submittal drawing shall identify control devices by number and physical location coordinated with the submittal drawing device numbers.

PART 3 - EXECUTION

3.1 RELAYS

A. All remote field devices shall be controlled through the use of an interposing relay.

3.2 INSTALLATION

A. No control work shall be performed until the control system shop drawings have been approved by the Engineer and returned to the contractor.

3.3 CONTROL WIRING

A. The installation and wiring of all electrical equipment installed under this contract shall meet all Division 16 specifications. Special attention is called to the following:

1. All wiring to be in conduit.

2. All control wiring to be color-coded throughout. Conductor color shall be consistent for the entire length of circuit.

3. All splices shall be made in junction boxes on terminal strips.

4. All control wiring to terminate on marked terminal strips and shall be marked at all terminal points. Both ends of each wire shall be marked with a designation shown on the manufacturer's shop drawings, using interlocking chevron shaped snap-on plastic markers, hot-marked shrinkable tubing, hot stamping of the wire, or clear shrink-on tubing securing adhesive labels. Markers which depend solely on adhesive are not acceptable.

B. Terminal strips shall be used in all boxes and cabinets where more than six control wires are terminated, spliced or both.

C. All control wiring shall be color coded and marked in each box, at each termination with Brady wrap around labels or suitable tags approved by the Architect. The schematic control diagrams shown on the contract drawings are for the convenience of the contractor and may not be complete in all details of control wiring for the equipment purchased for installation.

3.4 SYSTEM TESTING

A. The integrity and accuracy of each function and control point shall be demonstrated to the satisfaction of the Architect/Engineer during the test period. At the termination of the testing period the Contractor shall spend one working day instructing the Owner or his designated personnel in the control system operation. A complete operating booklet shall be provided and used during the training period.

B. Upon completion of the installation, the Contractor or his authorized representative shall be sent to the installation to certify that all necessary electrical tests and control adjustments have been completed. He shall then file a letter of Certification indicating that the system functions and conforms to the intent of these specifications.

END OF SECTION

SECTION 28 3000
FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section of the specification includes the furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Fire Alarm Control Panel (FACP), auxiliary control devices, annunciators, and wiring.

B. The contractor performing the fire alarm work is comprehensively responsible for interpreting all site and facility conditions, as existing and as intended to be improved, modified, or newly constructed. Contractor's fire alarm professional(s) shall be exclusively responsible to complete their own analysis of applicable code(s) and statute(s) in effect in order to perfect their own design, furnish, and install the system to the Owner's, Engineer's, and Authority Having Jurisdiction's satisfaction. The drawings, details, notations, provided and specified herein convey the minimum requirements required to aid the Contractor in the preparation of its offer to complete the work required through-out the contract documents. All devices, components, functionality, and securing approval of the authority having jurisdiction, shown or not shown, are to be installed without additional cost(s) to the Owner. No contract modifications shall be considered for components that could have been reasonably anticipated by visiting the site and review of the contract documents prior to engaging in the contract for this work.

C. The fire alarm system shall comply with requirements of NFPA for protected premises signaling systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

D. The fire alarm manufacturer shall be of the highest caliber and insist on the highest quality. The system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001 ANSI/ASQC Q9001-1994.

E. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). Whenever existing devices are to remain they shall be acceptable provided they integrate effectively with new equipment, and they're continued use is acceptable to the Authority Having Jurisdiction (AHJ).

F. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL listing.

G. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

H. The system shall be an active/interrogative type system where each transponder is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that the transponder and its associated initiating device and notification appliance circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.

I. The system shall be arranged such that not less than 20 percent additional transponders may be inserted into any network communication loop.

J. The installing company shall employ NICET (minimum Level III Fire Alarm Technology) technicians to supervise the creation of shop-drawings, calculations, installation, and commissioning to ensure the systems integrity.

1.2 SCOPE

A. The existing fire alarm system shall be modified and installed in accordance with the specifications and drawings.

B. Existing fire detection equipment may be reused where the equipment

1. Meets this specification section;

2. Is approved by a recognized national agency (UL,FM, etc.);

3. Is verified as compatible with new equipment being installed;

4. Is verified as operable through testing and inspection;

5. Is approved by the local Authority Having Jurisdiction (AHJ).

C. Basic Performance

1. Alarm and trouble signals from each transponder shall be digitally encoded by listed electronic devices onto an NFPA Style 6 looped multiplex communication system.

2. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto NFPA Style 6 Signaling Line Circuits.

3. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D).

4. Digitized electronic signals shall employ check digits or multiple polling.

5. A single ground or open on any system signaling line circuit, initiating device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

6. Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

D. Basic System Functional Operation

1. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur
   a) The System Alarm LED shall flash.
   b) A local piezo-electric signal in the control panel shall sound.
   c) The 80-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
   d) Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.
   e) All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

E. The Contractor shall coordinate the requirements of interconnected systems including sprinkler systems, HVAC Fire/Smoke Damper Detectors and HVAC Duct Detectors. The contract drawings may not show all sprinkler waterflow and supervisory switch connections. All waterflow, supervisory switches, HVAC Fire/Smoke Damper Detectors and HVAC Duct Detectors shall be connected to the Fire Alarm System at no additional cost to the owner.

1.3 SUBMITTALS

A. General

1. All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment.

2. Quantity of copies of all submittals shall be submitted to the Architect/Engineer for review as called for in the architectural specifications.

3. Contractor shall submit its shop drawings along with all necessary supporting documentation to the Authority Having Jurisdiction in order to obtain approval of the proposed fire alarm system.

4. Upon completion and final acceptance the contractor shall submit a fully executed Record of Completion endorsed by the AHJ.

B. Shop Drawings

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Provide scaled reproducible shop drawings that include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts and wiring requirements. These drawings shall only contain information regarding the Fire Alarm System.

3. Show annunciator layout and main control panel module layout, configurations and terminations.

C. Manuals

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets.

2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.

3. Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment and system.

4. Approvals will be based on complete submissions of manuals together with shop drawings.

D. Software Modifications

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

E. Certifications Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.4 GUARANTY

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials

required to correct any defect during this one-year period shall be included in the submittal bid.

1.5 POST CONTRACT MAINTENANCE

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

B. As part of the submittal, include a quote for a maintenance contract to provide all maintenance, test, and repair described below. Include also a quote of unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment and response travel costs. Submittals which do not identify all post contract maintenance costs will not be accepted. The rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Maintenance and testing shall be as required by the local AHJ. A preventive maintenance schedule shall be provided by the contractor which shall describe the plan for preventive maintenance of all devices and subassemblies requiring regular maintenance. The schedule shall include

1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water flow switches and all accessories of the fire alarm system.

2. Each circuit in the fire alarm system shall be tested semiannually.

3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72, Chapter 7.

1.6 POST CONTRACT EXPANSIONS

A. The contractor shall provide parts and labor to expand the system specified, if so requested, for a period of five (5) years from the date of acceptance.

B. As part of the submittal include a quotation for all parts and material, and all installation and test labor as needed to increase the number of intelligent or addressable devices by ten percent (10%). This quotation shall include intelligent smoke detectors, intelligent heat detectors, addressable manual stations, addressable monitor modules and addressable control modules equal in number to one tenth of the number required to meet this specification (list actual quantity of each type).

C. Quotation shall include installation and test labor and labor to reprogram the system for this 10% expansion. If additional loop interface hardware is required, include the material and labor necessary to install this hardware.

D. Do not include cost of conduit or wire or the cost to install conduit or wire except for labor to make final connections at the FACP and at each intelligent, addressable device. Do not include cost of conventional peripherals or the cost of

initiating devices or notification appliances connected to the addressable monitor/control modules.

E. Submittals which do not include this estimate of post contract expansion cost will not be accepted.

1.7 APPLICABLE PUBLICATIONS The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA) - USA

1. No. 70 National Electric Code (NEC)

2. No. 72-1993 National Fire Alarm Code

3. No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA

1. No. 50 Cabinets and Boxes

2. No. 268 Smoke Detectors for Fire Protective Signaling Systems

3. No. 864 Control Units for Fire Protective Signaling Systems

4. No. 268A Smoke Detectors for Duct Applications

5. No. 521 Heat Detectors for Fire Protective

6. No. 228 Door Closers-Holders for Fire Protective Signaling Systems

7. No. 464 Audible Signaling Appliances

8. No. 38 Manually Actuated Signaling Boxes

9. No. 346 Waterflow Indicators for Fire Protective Signaling Systems

10. No. 1481 Power supplies for Fire Protective Signaling Systems

11. No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems

12. No. 1971 Visual Notification Appliances

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS

A. The system must have proper listing and/or approval from the following nationally recognized agencies

1. UL Underwriters Laboratories Inc.

2. FM Factory Mutual

3. ULC Underwriters Laboratories Canada

4. MEA Material Equipment Acceptance (NYC)

5. CSFM California State Fire Marshal

B. The Fire Alarm Control Panel and all transponders shall meet the modular labeling requirements of Underwriters Laboratories, Inc. Each subassembly, including all printed circuits, shall include the appropriate UL modular label. Systems which do not include modular labels may require return to the factory for system upgrades, and are not acceptable.

Systems that do not include modular labels are not acceptable and may require return to the factory for upgrades.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

A. All equipment and components shall be new, and the manufacturer’s current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

B. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

C. All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 CONDUIT AND WIRE

A. Conduit

1. Conduit shall be in accordance with the National Electrical Code (NEC), local and state requirements.

2. Where possible, all wiring shall be installed in concealed conduit or raceway. Exposed conduit shall be red in color or have red banding identification within 3’-0” of every device or junction box and every 8’-0” along its entire route. Exposed conduit shall be ran as discretely as

possible vertically and horizontally in parallel with structural or architectural elements. Conduit fill shall not exceed 40 percent of interior cross-sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

4. Wiring for 24 volt control, alarm notification, emergency communication, and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. All conduits shall be bushed or terminated utilizing insulated throat fittings. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be 3/4 inch (19.1 mm) minimum.

7. Class A conduit per NFPA 72.

B. Wire

1. All fire alarm system wiring must be new. Existing wiring shall not be reused without the express written permission of the Owner and Engineer of record. All existing wiring shall be removed.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.32 mm) for Notification Appliance circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

5. Wiring used for the multiplex communication loop shall be twisted and shielded and installed in conduit unless specifically excepted by the fire alarm equipment manufacturer. The system should permit use of IDC and NAC wiring in the same conduit with the communication loop.

6. All field wiring shall be completely supervised.

C. Terminal Boxes, Junction Boxes and Cabinets All boxes and cabinets shall be UL listed for their intended purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The main fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution Panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold-water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL

A. The existing main FACP Central Console is a NOTIFIER AFP-100 unit and shall be modified as needed to accept the new devices per the drawings. The FACP shall communicate with and control the following types of equipment used to make up the system intelligent detectors, addressable modules, transponders, local and remote operator terminals, printers, annunciators, emergency voice communication systems and other system-controlled devices.

B. The main FACP shall perform the following functions

1. Supervise and monitor all intelligent/addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to transponders.

3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.

4. Visually and audibly annunciate any trouble, supervisory or alarm, condition on operator's terminal, panel display, and annunciators.

C. System Capacity and General Operation

1. The control panel shall provide, or be capable of expansion to, 198 intelligent/addressable devices per loop plus 2048 annunciation points per system.

2. The fire alarm control panel shall include a full featured operator interface control and annunciation panel which shall include a Bake lite Liquid Crystal Display (LCD), individual, color coded system status LEDs, and an alpha-numeric keypad for field programming and control of the fire alarm system.

3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

4. The system shall include emergency voice communications utilizing distributed amplification and intelligence such that loss of operation by the main FACP will not result in the loss of evacuation signal throughout the balance of the building.

5. The FACP shall provide the following features

a)	Block Acknowledge	Printer Interface
b)	Charger rate Control	CRT Display Interface
c)	Control-by-Time	Non-Alarm Module Reporting
d)	Day/Night Sensitivity	Periodic Detector Test
e)	Device Blink Control	Remote Page
f)	Drift Compensation	Trouble Reminder
g)	NFPA 72, Sensitivity Test	Upload/Download to PC computer
h)	System Status Reports	Verification Counters
i)	Security Monitor Points	Walk Test
j)	Alarm Verification	Maintenance Alert

D. Central Processing Unit (CPU)

1. The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the central processing unit.

2. The CPU shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.

3. The Central Processing Unit shall also provide a real-time clock for time annotation of all system displays. The Time-Of-Day and date shall not be lost if system primary and secondary power supplies fail.

E. Display

1. The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.

2. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.

3. The system display shall provide an 80-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide 5 light-emitting-diodes (LEDs), which will indicate the status of the following system parameters

AC POWER, SYSTEM ALARM; SYSTEM TROUBLE, DISPLAY TROUBLE, and SIGNAL SILENCE.

4. The system display shall provide a 25-key touch keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels will be accessible through the display interface assembly to prevent unauthorized system control or programming.

5. The system display shall include the following operator control switches SIGNAL SILENCE, LAMP TEST, RESET, SYSTEM TEST, and ACKNOWLEDGE

F. Signaling Line Circuit (SLC) Interface Board

1. The SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 intelligent detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.

2. The SLC interface board shall contain its own microprocessor and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the unlikely event of a failure in the main CPU.

3. The SLC interface board shall not require any jumper cuts or address switch settings to initialize operations.

4. The SLC interface board shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 7 (Class A) circuit.

5. The SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

G. Serial Interface Board (SIB)

1. The Serial Interface Board shall provide the EIA-232 interface between the fire alarm control panel and UL-Listed Electronic Data Processing (EDP) peripherals.

2. The SIB shall allow the use of multiple printers, CRT monitors, and other peripherals connected to the EIA-232 ports.

3. The Serial Interface Board shall provide one EIA-485 port for the serial connection of the optional annunciator and control subsystem components.

4. The SIB shall include LEDs which indicate that it is in regular communication with the annunciators and other EIA-485 connected peripheral devices.

5. All EIA-232 circuits shall be optically isolated and power limited.

H. Enclosures

1. The control panels shall be housed in UL listed cabinets suitable for surface or semi-flush mounting. Cabinets shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

2. The back box and door shall be constructed of .060 steel with provisions for electrical conduit connections into the sides and top.

3. The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.

4. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

I. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

J. The CPU and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL864 standards.

K. Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.

L. Power Supply

1. The Main Power Supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.

2. It shall provide 3.0 amps of usable notification appliance power, using a switching 24 VDC regulator.

3. It shall be expandable, for additional notification appliance power, in 3.0 ampere increments.

4. It shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. It shall charge up to 55 Amp Hour batteries with-in a 48 hour period.

5. It shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults on sensitive addressable modules.

6. It shall be power-limited per 1995 UL864 requirements.

7. It shall provide meters to indicate battery voltage and charging current.

8. The power supply shall be capable of charging NICAD batteries up to 32

M. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and a UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The connection between the UDACT and the control panel shall be completely supervised.

2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA requirements. It shall include the ability for split reporting of panel events.

3. The UDACT shall be completely field programmable from a built-in keypad and 4 character red, seven segment display.

4. The UDACT shall be capable of transmitting events in at least 9 different formats. This ensures compatibility with existing and future transmission formats. Accepted formats include
   a) 3+1 Standard - 4+1 Standard
   b) Ademco Contact ID - 4+1 and 4+2 Ademco

5. Communication shall include vital system status such as
   a) Independent Zone (Alarm, trouble, non-alarm)
   b) Independent Zone Supervisory Signal
   c) AC (Mains) Power Loss
   d) Low Battery and Earth Fault
   e) System Off Normal
   f) 12 and 24 Hour Test Signal
   g) Abnormal Test Signal (per UL requirements)
   h) EIA-485 Communications Failure

6. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 2,040 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

N. Field Charging Power Supply The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.

1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to support 60 hour standby.

2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Z or Y) shall be available for connection to the Notification devices.

3. The FCPS shall include an attractive surface mount backbox.

4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per 1993 NFPA requirements.

5. The FCPS include power limited circuitry, per 1995 UL standards.

O. System Circuit Supervision

1. The FACP shall supervise all circuits to intelligent devices, annunciators and conventional peripherals and annunciate loss of communications with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate that device or devices are not responding and print the information on the printer.

2. Sprinkler system valves, standpipe control valves, PIV and main gate valves shall be supervised for off-normal position.

P. Field Wiring Terminal Blocks

1. For ease of service, all wiring terminal blocks shall be the plug-in type and have sufficient capacity for 18 to 12 AWG wire. Fixed terminal blocks are not acceptable.

Q. Operators Terminal: Provide the following functions in addition to any other functions required for the system.

1. Acknowledge (ACK/STEP) Switch
   a) Activation of the control panel Acknowledge switch in response to a single new Alarm and/or trouble condition shall silence the local panel piezo electric signal and change the system alarm or trouble LED from flashing mode to steady-ON mode. If additional new Alarm or Trouble conditions exist or are detected and reported in the system, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.
   b) Depressing the acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Signal Silence Switch
   a) Activation of the signal silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm activation. The selection of notification circuits and relays which are silenceable by this switch shall be fully field programmable within the confines of all applicable standards.

3. System Reset Switch
   a) Activation of the system reset switch shall cause all electronically latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
   b) If an alarm condition(s) still exists, or if they reoccur in the system after system reset switch activation, the system shall then resound the alarm conditions.

4. System Test Switch.
   a) Activation of the system test switch shall initiate an automatic test of all Intelligent/Addressable detectors in the system. The system test shall activate the electronics in each intelligent sensor, simulating an alarm condition and causing the transmission of the alarm condition from that sensor to the fire alarm control panel. The fire alarm control panel shall interpret the data from each sensor installed in the system. A report summarizing the results of this test shall be displayed automatically on the system LCD, and on any CRTs or printers in the system.

5. Lamp Test Switch
   a) Activation of the lamp test switch shall sequentially turn on all LED indicators, system liquid crystal display and local piezo signal, and then automatically return the fire alarm control panel to the previous condition.

R. Remote Transmissions

1. Provide local energy or polarity reversal or trip circuits as required.

2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.

3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.

4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

S. System Expansion Design the main FACP and transponders so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

T. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits.

2. All programming shall be accomplished through the standard FACP keyboard or through the video display terminal.

3. All field defined programs shall be stored in non-volatile memory.

4. The programming function shall be enabled with a password that may be defined specifically for the system when it is installed. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level is used for status level changes such as zone disable or manual on/off commands. A second (higher-level) is used for actual change of program information.

U. Specific System Operations

1. Smoke Detector Sensitivity Adjust Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.

2. Alarm Verification Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The FACP shall keep a count of the number of times each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

3. System Point Operations
   a) Any device in the system may be enabled or disabled through the system keypad or video terminal.
   b) Any system output point may be turned on, or off, from the system keypad or the video terminal.

4. Point Read The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point will be annunciated for the parameters listed
   a) Device Status.
   b) Device Type.
   c) Custom Device Label.
   d) Software Zone Label.
   e) Device Zone Assignments.
   f) Detector Analog Value.
   g) All Program Parameters.

5. System Status Reports Upon command from a password-authorized operator of the system, a status report will be generated, and printed, listing all system status.

6. System History Recording and Reporting The fire alarm control panel shall contain a History Buffer that shall be capable of storing up to 400 system output/input/control activations. Each activation will be stored, and time and date stamped with the actual time of the activation, until an operator requests that the contents be either displayed or printed. The contents of

the History Buffer may be manually reviewed, one event at a time, and the actual number of activations may also be displayed and or printed.

7. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

8. Automatic Detector Maintenance Alert The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

9. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the Trouble Mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

2.4 SYSTEM COMPONENTS

A. Programmable Electronic Sounders

1. Electronic sounders shall operate on 24 VDC nominal.

2. Electronic sounders shall be field programmable without the use of special tools, to provide slow whoop, continuous, or interrupted tones with an output sound level of at least 90 dBA measured at 10 feet from the device.

3. Shall be flush or surface mounted as shown on plans.

B. Strobe Lights shall be combination strobe-mini sounder units.

1. Shall operate on 24 VDC nominal.

2. Shall meet the requirements of the ADA as defined in UL standard 1971 and shall meet the following criteria
   a) The maximum pulse per UL 1971.
   b) Candela intensity shall meet the requirements of UL 1971.
   c) The flash rate shall meet the requirements of UL 1971.
   d) The appliance shall be placed 80 in (2,030 mm) above the highest floor level within the space, or 6 in (152 mm) below the ceiling, whichever is lower.
   e) Where two or more strobes may be viewed those strobes shall be synchronized.
   f) The design intent with the strobe and strobe/horn units is to meet ADA and NFPA requirements regarding unit candela rating. The contractor shall provide the corresponding strobe in the respective areas. The intent of this requirement is to minimize power supplies. Contractor shall show these candela ratings on shop drawings.

C. Audible/Visual Combination Devices

1. Shall meet the applicable requirements of Section A listed above for audibility.

2. Shall meet the requirements of Section B listed above for visibility.

D. Addressable Devices - General

1. Addressable devices shall provide an address-setting means using rotary decimal switches.

2. Addressable devices shall use simple to install and maintain decade (numbered 1 to 10) type address switches. Devices which use a binary address setting method, such as a dip switch, which are difficult to install and subject to installation error. This type of device is not an allowable substitute.

3. Detectors shall be Intelligent and Addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

4. Addressable smoke and thermal detectors shall provide dual (2) alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs shall be optional through the system field program. An output connection shall also be provided in the base to connect an external remote alarm LED.

5. Smoke detector sensitivity shall be set through the Fire Alarm Control Panel and shall be adjustable in the field through the field programming of the system. Sensitivity may be automatically adjusted by the panel on a time-of-day basis.

6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.

7. The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature. An optional base shall be available with a built-in (local) sounder rated at 85 DBA minimum.

8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

E. Addressable Pull Box (manual station)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall be double-action and shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual stations shall be double action and constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.

4. Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.

F. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

G. Intelligent Ionization Smoke Detector

1. The detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

H. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit. Up to 99 intelligent heat detectors may connect to one SLC loop.

I. Intelligent Duct Smoke Detector

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help

prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

3. Fire alarm addressable duct detectors and fire alarm addressable relays for fan shutdown shown on the HVAC equipment will be addressed as follows:
   a) Duct detectors shall be provided by the division 16 contractor and installed by the division 15 contractor. Fan shutdown relay shall be provided and installed by the division 16 contractor. Division 15 controls contractor shall connect the relay for fan shutdown. The division 16 special systems contractor shall monitor both devices.

J. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLC loops.

2. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.

3. The IDC zone may be wired for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

4. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch x 1-1/4 inch x 1/2 inch. This version need not include Style D or an LED.

K. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).

2. The two-wire monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box or with an optional surface backbox.

3. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

L. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.

3. The control module NAC may be wired for Style Z or Style Y (Class A) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

4. Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply.

5. The control module shall be suitable for pilot duty applications and rated for a minimum of .6 amps at 30 VDC.

M. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop. At least one isolator module shall be provided for each floor or protected zone of the building.

2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

3. The isolator module shall not require any address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

4. The isolator module shall mount in a standard 4-inch deep electrical box or in a surface mounted backbox. It shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

N. LCD Alphanumeric Display Annunciator

1. The alphanumeric display annunciator shall be a supervised, locally or remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text.

2. The LCD annunciator shall display all alarm and trouble conditions in the system.

3. Up to 32 LCD annunciators may be connected to a specific (terminal mode) EIA 485 interface. LCD annunciators shall not reduce the annunciation

capacity of the system. Each LCD shall include vital system wide functions such as, System Acknowledge, Silence and Reset.

4. LCD display annunciators shall mimic the main control panel 80-character display and shall not require special programming.

2.5 BATTERIES AND EXTERNAL CHARGER

A. Battery

1. Shall be 12 volt, Gel-Cell type.

2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

B. External Battery Charger

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120-volt 60 hertz source.

2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.

3. Shall have protection to prevent discharge through the charger.

4. Shall have protection for overloads and short circuits on both AC and DC sides.

PART 3 - EXECUTION

3.1 INSTALLATION

C. Installation shall be in accordance with the NEC, NFPA72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

D. All conduit, junction boxes, conduit supports, and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

E. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

3.2 TYPICAL OPERATION

A. Actuation of any manual station, smoke detector, heat detector or water flow switch shall cause the following operations to occur unless otherwise specified

1. Activate all programmed speaker circuits.

2. Actuate strobe units until the panel is reset.

3. Light the associated indicators corresponding to active speaker circuits.

4. Release all magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated.

5. Return all elevators to the primary or alternate floor of egress.

6. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.

7. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.

8. Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as appropriate.

9. Activation of any sprinkler system low pressure switch, on valve tamper switch, shall cause a system supervisory alarm indication.

3.3 TEST

A. Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

2. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

3. Verify activation of all flow switches.

4. Open initiating device circuits and verify that the trouble signal actuates.

5. Open signaling line circuits and verify that the trouble signal actuates.

6. Open and short notification appliance circuits and verify that trouble signal actuates.

7. Ground initiating device circuits and verify response of trouble signals.

8. Ground signaling line circuits and verify response of trouble signals.

9. Ground notification appliance circuits and verify response of trouble signals.

10. Check alert tone and prerecorded voice message to all alarm notification devices.

11. Check installation, supervision, and operation of all intelligent smoke detectors using walk test.

12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

13. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.4 FINAL INSPECTION

A. At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

B. Upon completion and final acceptance, the contractor shall submit a fully executed Record of Completion endorsed by the AHJ.

3.5 INSTRUCTION

A. Provide instruction as required for operating the system. "Hands-on" demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer’s representatives shall provide a typewritten "Sequence of Operation" to the Owner.

END OF SECTION

SECTION 26 0000
ELECTRICAL INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

B. Requirements of Division 27 and 28 Sections apply to this Section when applicable and as illustrated on drawings.

1.2 DESCRIPTION OF WORK

A. Furnish all service tools, equipment, etc., which are required for the complete installation of all Electrical Work, as indicated on the Drawings and specified herein. Electrical work indicated on the Drawings and/or specifications covering other trades shall conform to Division 26 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Electrical systems, shall be accomplished without additional cost to the Owner.

C. Furnish all labor and materials required for electrical service and control connections to all the various items of equipment requiring electric or wiring service throughout the project shown on the Contract Drawings (even if not shown on the Electrical Drawings). Coordinate with other trades for the installation of required connections and service.

1.3 ELECTRICAL DIVISION INDEX

26 0500	GENERAL ELECTRICAL PROVISIONS
26 0519	LOW VOLTAGE CONDUCTORS
26 0526	GROUNDING
26 0533	RACEWAYS, BOXES, AND FITTINGS
26 0553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 2726	WIRING DEVICES AND PLATES
26 2800	MOTOR AND CIRCUIT DISCONNECTS
26 2813	FUSES
26 5119	LED INTERIOR LIGHTING

PART 2 – PRODUCTS (Not used.)

PART 3 – EXECUTION (Not used.)

END OF SECTION

SECTION 26 0500
GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

B. The documents form part of the Specifications to the extent stated. Where differences exist between codes, the most stringent shall apply.

1.2 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

A. Regulatory Agencies: Installation, materials, equipment and workmanship shall conform to the applicable provisions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), Occupational Safety and Health Act (OSHA) all local, state and national codes, ordinances and regulations governing the particular class of work involved and the terms and conditions of the electrical utility and other authorities having lawful jurisdiction pertaining to the work required. All modifications required by these codes, rules, regulations and authorities shall be made by the Contractor without additional charge to the Owner. The Contractor shall secure all permits and licenses required for his work and shall pay all fees in connection with such permits and licenses.

B. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved; and, on completion of the work, the Contractor shall obtain and deliver to the Owner, final certificates of acceptance. The Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. Underwriter's Laboratories (UL): All materials, appliances, equipment or devices shall conform to the applicable standards of Underwriter's Laboratories, Inc. where such standards have been established.

D. Standards: The current edition of the following specifications and standards shall form a part of these specifications:

1. National Fire Protection Association Standards
2. National Electrical Code, NFPA 70 (NEC)
3. Life Safety Code, NFPA 101
4. NFPA 72
5. Occupational Safety and Health Act (OSHA)
6. National Electrical Safety Code (NESC)
7. Underwriter's Laboratories, Inc. (Standards)

8. American National Standards Institute (ANSI)

9. American Society of Testing and Materials (ASTM)

10. Institute of Electrical and Electronic Engineers (IEEE)

11. Insulated Cable Engineer's Association (ICEA)

12. National Electrical Manufacturer's Association (NEMA)

13. Americans with disabilities Act Accessibility Guidelines (ADA)

1.3 DRAWINGS

A. The electrical drawings show the general arrangement of all conduit, outlets, equipment, etc. and shall be followed as closely as actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as a part of the work insofar as these drawings furnish the Contractor with information relating to the design and construction of the building. Architectural drawings shall take precedence over electrical drawings. Because of the small scale of the electrical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, elbow, pullboxes, and accessories as may be required to meet such conditions.

B. The Contractor shall verify the dimensions governing the electrical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings.

C. Drawings and specifications shall be considered as complementary. Work or materials called for by one and not mentioned in other shall be provided as though treated by both.

D. In the case of conflict between drawings and specifications, the greater or more restrictive requirement shall apply.

E. Any question as to the intent of the drawings or specifications shall be referred to the Architect/Engineer, whose decision shall be final and conclusive.

F. Should the Contractor observe any conflict or variation in the plans and specifications, he shall notify the Architect/Engineer in writing no later than seven (7) days prior to date of bid opening. Failure to clarify such variations will result in the Contractor bearing all costs arising from electrical work necessary to resolve the conflict or variation.

1.4 SERVICES

A. General: Requirements of the serving power and telephone utilities and availability of services have been determined as accurately as possible. The Contractor shall verify availability of services and determine actual details

pertaining to the exact locations and requirements of utilities before submitting bid. No consideration for extra cost will be given resulting from failure to comply with these requirements by the Contractor. Contractor shall immediately notify the serving utilities that he has the job, and also furnish information as to the total lighting and power loads for the job. He shall also furnish, at the same time, information as to the established completion date of the job.

B. Telephone: Contractor shall immediately notify the serving utility of the estimated date when service will be desired.

1.5 AS-BUILT DRAWINGS

A. During progress of the work, the contractor shall maintain an accurate record of the installation of the system, locating each outlet, and note all circuiting deviations from the contract drawings. Upon completion of the installation, the contractor shall transfer all record data to a single neat and legible set of prints of the original drawings.

1.6 OPERATING INSTRUCTIONS AND MANUALS

A. Instructions: Without additional charge to the Owner, furnish competent instruction to the Owner in the care, adjustment, and operation of all parts of the electrical equipment and systems.

B. Manuals: Upon completion of the work, prepare and deliver to the Owner two (2) sets of complete operating and maintenance manuals for the systems and major equipment installed, suitably bound in book form and must be originals. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists and manufacturer's operating and maintenance data.

C. Other: The above requirements are in addition to specific instructions and manuals specified for individual systems or equipment.

1.7 SITE VISIT

A. The Contractor shall visit the site prior to bidding and satisfy himself as to the conditions under which the systems are to be installed. No subsequent allowance shall be made in his behalf for failure to make such a visit.

1.8 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the work. No extra compensation shall be claimed or allowed due to difference between actual dimensions and those indicated on the drawings. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting the work.

1.9 PERFORMANCE TESTS

A. Thoroughly test all fixtures, batteries, services, and all circuits for proper operating condition, required durations and freedom from grounds and short

circuits before acceptance is requested. All equipment, appliances and devices shall be operated under load conditions.

B. After the interior wiring system installation is complete and at such time as the Architect/Engineer may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices, and equipment after installation, to assure that all material continues to possess all the original characteristics as required by governing codes and standards listed in these specifications.

C. After occupancy of the building has taken place and nominal building power loads established, make voltage readings at all panelboards. Based on these readings, make final adjustments of taps on all transformers in the building as directed.

D. Perform such other tests as required by other sections of these specifications or as requested to prove acceptability.

E. Furnish all instruments and labor for testing.

1.10 REMODELING WORK

A. Where remodeling work is indicated, the Contractor shall be responsible for all electrical work associated with changes in, or removals of existing walls, ceilings, or floors. This work shall include rerouting of conduits, relocation of fixtures, devices, and conduits as well as provision for circuit continuity for circuits in remodeled areas. The cost of all of this work shall be included in the Contractor’s price with no additional compensation allowed for failure to include this work.

1.11 MISCELLANEOUS ITEMS

A. Miscellaneous items not covered in these specifications shall be as indicated on the drawings, installed, and connected in the proper manner and as recommended by the manufacturer.

1.12 GUARANTEE

A. All equipment and workmanship to be furnished under this contract shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, design, and workmanship. Upon receipt of notice from the Owner of failure of any part of the guaranteed equipment during the guarantee period, the affected part or parts shall be replaced promptly with new parts by and at the expense of the Contractor. The labor incident to the installation of these replacements shall be furnished by the Contractor.

1.13 STANDARDS OF MATERIAL AND WORKMANSHIP

A. All material shall be new and shall bear the label of the Underwriter's Laboratories, Inc., or be listed under re-examination service. All material shall be of the best grade and latest pattern of manufacture as specified. All work shall be performed in a neat, workmanlike manner and shall present a neat mechanical appearance when completed.

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

A. The electrical requirements for equipment specified or indicated on the drawings are based on information available at the time of design. If equipment furnished for installation has electrical requirements other than indicated on the electrical drawings, the Contractor shall make all adjustments to wire and conduit size, controls, overcurrent protection and installation as required to accommodate the equipment supplied, without additional charge to the Owner. The complete responsibility and costs for such adjustments shall be assigned to the respective section of this specification under which the equipment is furnished.

2.2 MATERIALS

A. When the product of a specific manufacturer is indicated on the drawings or specified herein by catalog number or trade name, it has been done for convenience in fixing the standard for workmanship, finish, design, and the guaranteed performance. Any material, apparatus, or appliance which the Contractor desires to substitute for those mentioned herein shall also conform to these standards or exceed them and shall follow the procedure as outlined under substitutions and specified herein.

B. All similar materials and equipment shall be the product of the same manufacturer.

C. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the contract requirements and meets the approval of the Architect/Engineer.

D. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.

E. Altitude: Equipment affected by altitude shall perform satisfactorily for the function intended at the altitude of the project site.

2.3 NAMEPLATES

A. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates, constructed from laminated phenolic plastic, at least 1/16" thick, three-ply, black surface and white core. Plates shall be attached using stainless plate screws unless indicated otherwise. Nomenclature on the label shall include the name of the item and feeder circuit number. Equipment to be labeled shall include, but not be limited to, the following:

1. Air Conditioning Control

2. Contactors

3. Panels and Switches

4. Time Switches

5. Relays

6. Disconnect Switches

7. Starters

8. Transformers

9. Miscellaneous

10. Similar and/or related items

2.4 IDENTIFICATION AND SIGNS

A. Label each individual motor controller, disconnect switch, transformer and remote control device to identify each item and its respective service.

B. Provide nameplates with engraved lettering not less than 3/8 inch high where specified or noted. In general, use white core laminated plastic, attached with screws. Embossed plastic adhesive tape is not acceptable. Flush mounted devices may have identification engraved in the device plate.

C. Provide warning signs on all equipment or devices operating at 300 volts or more, reading “DANGER - 480 VOLTS” (insert respective voltage) etc., with white letters on red background of standard code size. Signs may be decals, stencils or nameplates.

D. Identify panelboards and cabinets by nameplates with descriptions indicated on the drawings together with voltage and phase. Install on outside of hinged doors of panelboards and cabinets.

2.5 CHANGES

A. No changes shall be made in the electrical work as shown and herein specified, unless such changes are authorized in writing by the Architect/Engineer and such authorization shall contain a statement covering the amount of the charges involved in the change.

2.6 SUBSTITUTIONS

A. On all material, substitutions will be considered only if requested by letter from the Contractor to the Architect/Engineer. Letters must be in the engineer's office no later than 10 days prior to the bid date and shall be considered as authorized only upon written confirmation from the Architect/Engineer. Where materials are proposed to be substituted in lieu of the items specified, substitutions shall be equal in quality, workmanship, and design. The burden of proof of equality of materials shall be placed upon the Contractor. Samples of all materials proposed for substitution shall be submitted to the Architect/Engineer, when requested, for examination.

2.7 SHOP DRAWINGS

A. Shop drawings shall be furnished for all equipment and materials. They shall be furnished by the Contractor as required in the Submittal Section. Where equipment will be furnished "as specified," a statement to that effect is sufficient. Where substitutions are proposed, complete data must be furnished showing performance, quality, and dimensions.

B. The Contractor shall submit to the Architect/Engineer for checking a complete descriptive and technical data list for all items of material furnished under this contract. Complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of special nature or critical to the installation and pertinent data required for installation shall be shown. Fixture submittals shall include scale drawings showing metal gauges and finish together with complete photometric distribution curves and coefficient of utilization tables. Glare factor curves shall also be submitted for each fixture. Failure to submit this information can be the basis for disapproval.

C. All descriptive and technical data and shop drawings shall bear signed certification that they have been carefully examined and found to be correct with respect to dimension, space available, non-interference with other trades and that the equipment complies with all the requirements of these specifications. Submittals that have not been checked for compliance will not be considered by the Engineer.

D. Only complete submittals will be considered, partial submittals will not be reviewed.

2.8 SUBMITTALS

A. Submittals shall be complete; bound booklets with an index of all items submitted including associated catalog/part numbers. The Contractor shall make submittals on all the following equipment (in addition to any special items indicated elsewhere in the plans or specifications):

1. Lighting Fixtures and Lighting Control(s)
2. Wiring devices
3. Conduit
4. Wire
5. Panelboards
6. Fuses
7. Starters
8. Contactors

9. Disconnect switches

10. Special Systems equipment (Fire Alarm, Intrusion Alarm, Sound, TV, Lightning Protection, etc.).

11. Dimensioned Electrical Room(s) and Data/IT Room(s) with complete layout of proposed equipment at scale with all clearance requirements identified to be in compliance with the NEC.

B. Electrical System Controls: Refer to Section 253000 for additional submittal requirements.

C. After receiving approval on the make and the type of materials, the Contractor shall order such materials in sufficient time to prevent any delay or changes on the job.

PART 3 - EXECUTION

3.1 GENERAL

A. Fabrication, erection and installation of the complete electrical system(s) shall be done in a first class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Contractor shall check all areas and surfaces where electrical equipment material is to be installed, removed, or relocated and report any unsatisfactory conditions before starting work. Commencement of work signifies the Contractor's acceptance of existing conditions. In the acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of workmen.

3.2 EQUIPMENT

A. Equipment and materials furnished by the Contractor shall fit the spaces allocated for them. Should the equipment which the Contractor proposes to install, require space conditions other than indicated on the drawings, it shall be the Contractor's responsibility to reconcile the available space with the equipment and make any changes required to accommodate the equipment. All required changes shall be made at the Contractor's expense.

B. All equipment, both the Contractor and Owner furnished, shall be installed in accordance with the manufacturer's recommendations.

3.3 COORDINATION

A. The Electrical Plans are diagrammatic, but shall be followed as closely as actual construction and the work of other trades will allow. Such minor changes as are necessary to make the electrical work conform to the work of other trades and to the building shall be made without cost to the Owner.

3.4 CIRCUITS AND FEEDERS

A. Circuits and feeders shall be as shown and no deviations from the indicated outlet-circuit grouping will be permitted, except by permission of the Architect/Engineer. Branch circuit numbers are mandatory and shall be changed only on written permission from the Architect/Engineer. Any changes in layout or circuit numbering shall be accurately recorded on the "As-Built" drawings.

3.5 CONDUITS

A. In all spaces, such as ceiling spaces and equipment rooms, all conduits shall be run to a continuous grade and square to the building.

B. The plans do not give exact details as to the elevations of conduits, exact locations, etc., and do not show all off-sets, bends, junction boxes and other installation details. The Contractor shall carefully lay out his work at the site to conform to details of installation.

3.6 LOCATION OF EQUIPMENT AND OUTLETS

A. The approximate locations of cabinets, panelboards, wiring gutters, switches, light outlets, power outlets, etc., are indicated on the drawings; however, they are not intended to give complete and exact information. Determine the exact location after thoroughly examining the general building plans and by actual measurements during construction, subject to the approval of the Architect/Engineer.

B. Verify with Architect/Engineer, prior to installation, all locations of conduit, boxes, etc. stubbed or in the floor.

3.7 PROTECTION OF MATERIALS AND EQUIPMENT

A. The Contractor shall be responsible for the protection of all materials and equipment under this section of the work whether incorporated into the building or not.

B. The Contractor shall provide protection for all work where necessary and will be responsible for all damage done to property during the construction. The above protection shall be maintained while the work is in progress. In no case shall dirt, grit, etc., be ground into the floor finish or coverings.

C. The Contractor shall provide space for storage of materials and equipment at ground level.

3.8 CUTTING AND REPAIRING

A. Cutting and repairing shall be the responsibility of the Contractor. Coordinate to prevent unnecessary cutting and repairing. Lay out and locate equipment, openings, and chases. Install sleeves, inserts, and supports.

B. When applicable, any and all repairs made to warrantable surfaces or systems shall be made in a fashion to preserve the warranty and meet the manufacturer's recommendations.

3.9 EXCAVATION AND BACKFILLING

A. The Contractor shall do all necessary excavation and backfill for the installation of the systems as may be required. Curb cuts, asphalt, and concrete patching, etc., shall be part of the Contractor's responsibility. Prior to any required trenching, contractor shall have all utilities identified and will be done by hand within 36" of all existing utilities. Damage done to existing utilities will be repaired by the Contractor with no additional payment for the work. In addition to the above, trenches shall be backfilled with dirt, free from debris, rocks, and other foreign matter. Backfill shall be replaced in the trenches in 6" layers and each 6" layer shall be wetted down adequately and properly tamped. Remove surplus dirt and leave premises clean.

B. Perform excavation, backfilling and surface repairs required for work under this Division in accordance with OSHA and other requirements of the contract documents. In general, backfill and tamp with compaction at least equal to that of the surrounding area or as prescribed by structural engineer of record.

C. Contractor shall restore all existing and new surfaces to comply with ADA ordinances, the Contract documents, or existing surrounding conditions.

3.10 WARRANTY

A. Deliver originals of all guarantees and warranties on this portion of the work to Owner. Warrant all equipment, materials, and workmanship for one year minimum in accordance with the terms of this Contract or as required elsewhere in the contract documents.

3.11 PRODUCT HANDLING

A. Use all means necessary to protect electrical materials and equipment before, during and after installation and to protect the installed work of other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no extra cost to him.

END OF SECTION

SECTION 26 0519
LOW VOLTAGE CONDUCTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install all conductors as required for the complete installation and operation of all electrically serviced and/or operated equipment, devices and systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of Division 26 Sections apply to this Section when applicable.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (600 VOLTS)

A. Type: Conform to the applicable UL and ICEA Standards for the use intended. Copper conductors with 600-volt insulation unless otherwise specified or noted on the drawings. Stranded conductors for No. 6 and larger except where elsewhere specified or noted on the drawings.

B. Use of aluminum conductors will not be permitted unless explicitly illustrated otherwise, or prior approved.

C. Insulation: Type THWN, 75-degree C. insulation unless otherwise specified or noted on the drawings. 90 degrees C. minimum insulation within fixture wireways of fluorescent fixtures. Where 90-degree C. insulation is specified, the termination points for this conductor shall be rated for 90 degrees C.

D. Size: No. 12 minimum unless otherwise specified or noted on the drawings. In the case of "homeruns", no conductor smaller than #10 shall be used for runs over 100 feet in length on 120-volt circuits. Not less than NEC requirements for the system to be installed. If the equipment to be installed requires larger conductor and conduit sizes than indicated on the drawings, the required changes shall be made without additional charge. Remote control wires, other than Class 2 remote control and signal circuits, shall be no smaller than #14.

E. Color Coding: Phase, neutral and equipment ground conductors color-coded. Connect all conductors of the same color to the same phase conductor. Color

coding shall be A-black, B-red, C-blue, N-white, for 250 volts or less. A-yellow, B-orange, C-brown, N-off white or grey, for 251-600 volts, with green for all equipment ground conductors. Conductors No. 12 and 10 shall be solid color compounded for the entire length. Conductor sizes larger than No. 10 may be color coded at each termination and in each box or enclosure with six inches of half-lapped 3/4-inch pressure sensitive, plastic tape of respective colors in lieu of solid color compound. The equipment grounding conductor shall be bonded to the outlet box grounding screw with taps to receptacles and equipment. Isolated ground conductors shall be green in color with a yellow trace.

2.2 CONTROL CONDUCTORS

A. Copper, minimum size No. 14 with 19/35 stranding, color coded filled cross linked polyethylene 75-degree C. 600-volt insulation and neoprene or equal outer jacket. Multi conductor control cables shall be provided where more than three control conductors are installed in the same conduit between common terminations. Provide two spare conductors minimum in each control cable.

2.3 DATA/COMMUNICATION AND ELECTRONIC CABLE

A. As required or specified in the section of these specifications specifying the equipment. Splices shall be twisted and soldered or shall use an approved connector.

B. All Cat. 6 cabling shall be tested in accordance with EIA/TIA performance standards. Refer to Division 27 for more detailed information.

2.4 VERTICAL CABLE SUPPORTS

A. Split wedge type supports which clamp each individual conductor and tightens due to weight of the cable shall be used for cables without metallic sheath. Basket weave type supports shall be used for cables with metallic sheath.

2.5 CONNECTORS AND LUGS

A. For Copper Conductors No. 6 and Smaller: Compression or indent type connectors with integral or separate insulating caps.

B. For Copper Conductors Larger Than No. 6: Solderless, indent, hex screw, compression, or bolt type pressure connectors, properly taped or insulated.

2.6 TAPE

A. Plastic tape, 8.5 mils minimum thickness, 1,000,000 megohms minimum insulation resistance, oil resistant vinyl backing, oil resistant acrylic adhesive, incapable of supporting combustion per ASTM D-568 Test Method B.

PART 3 - EXECUTION

3.1 CONDUIT SYSTEMS

A. A complete system of conductors shall be installed in the raceway systems. All conductors of all systems shall be installed in raceway or conduit unless explicitly illustrated otherwise or prior approved.

B. Lighting fixtures shall not be used as raceways for circuits other than parallel wiring of fixtures. Wiring in fixtures shall be rated for that purpose.

C. When leaving a metal raceway or conduit in a cabinet, box, switch, enclosure, control enclosure or any other like member, conductors shall be protected by means of insulated bushings or end fittings. These protectors shall be "O.Z." type or similar.

D. Parallel conductors may be provided when larger than #1/0 and all phased conductors are the same size, length and type of insulation. Multiple runs are to be in separate conduits. Each conduit to include one set of phase conductors, neutral and grounding conductors.

E. No splices or taps shall be made in any conductors except in outlet boxes, pull boxes, junction boxes, panelboard boxes, manholes or splice boxes. All taps and splices shall be made with solderless connectors and insulated in such a manner that provides an effective insulation equal to that of the adjoining wire. Any splice or tap shall be made only on conductors which are a component part of a single circuit properly protected by approved methods.

F. Before any wire is pulled into any conduit, the conduit shall be thoroughly swabbed in such a manner as to remove all foreign material and to permit the wire itself to be pulled in a clean, dry conduit. The Contractor shall use only approved wire pulling lubricants for pulling any wire. All conductors shall be pulled into their respective conduits by hand, except where written permission of the Engineer is secured to the contrary.

3.2 WIRE AND CABLE TESTS (600 Volts)

A. Measure the insulating resistance of service entrance conductors, feeder circuit conductors and service ground. Measurements shall be taken between conductors and between conductors and ground. Resistance shall be 1,000,000 ohms or more when tested at 500 volts by megger without branch circuit loads. Tests and procedures shall meet the approval of the Architect/Engineer and shall be in accordance with the applicable IPCEA standards for the wires and cables to be installed. Furnish all instruments, equipment and personnel required for testing and conduct tests in the presence of the Architect/Engineer. Submit written reports of the tests and results when requested.

3.3 PULL WIRES

A. In each empty conduit, except underground conduits, install a No.14 galvanized steel pull wire or a plastic line having a tensile strength of not less than 200

pounds. In each empty underground conduit, install a No. 10 AWG bare, hard drawn copper or copper clad pull wire or a plastic line having a tensile strength of no less than 200 pounds.

3.4 IN RACEWAYS

A. Install conductors in rigid conduit, EMT or flexible metallic conduit, unless otherwise specified or noted on the drawings.

3.5 CABLE BENDS

A. Radius of bends not less than 10 times the outer diameter of the cable.

3.6 BUNDLING

A. In cabinets conductors No. 10 and smaller shall be neatly and securely bundled and conductors larger than No. 10 shall be neatly and securely cabled in individual circuits.

3.7 CONDUCTOR PULL

A. Conductors shall not be pulled into conduits until after all plastering or concrete work is completed and all conduits in which moisture has collected have been swabbed out.

3.8 FEEDER IDENTIFICATION

A. Tag feeder circuits in each enclosure with wrap around circuit designation labels where more than one feeder passes through or terminates in the enclosure.

3.9 CONNECTORS AND LUGS

A. Install with manufacturer's recommended tools and with the type and quantity of deformations recommended by manufacturer.

B. Contractor shall review one-line and other Drawings to assure that proper lugs are provided in termination equipment such as switches, panels, switchboards, mechanical equipment, etc. Due to voltage drop conductor sizes and/or numbers may not be accommodated by the equipment affected. If manufacturer cannot provide the proper number and size of lugs within their equipment the Contractor shall provide enclosures and properly sized terminals to convert the oversized cable, number and size that is compatible to the equipment affected.

END OF SECTION

SECTION 26 0526
GROUNDING

PART 1 - GENERAL

1.1 RELATED WORK IN OTHER SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of Division 26 Sections apply to this Section when applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials, equipment, and devices related to the grounding system are specified under other sections of these specifications.

PART 3 - EXECUTION

3.1 GENERAL

A. Install two separate grounding systems, a service grounding system and an equipment grounding system. The service equipment, conduit systems, supports, cabinets, equipment, and neutral conductor shall be grounded in accordance with the minimum code requirements and as further indicated on the drawings or specified. Connect the two grounding systems together only at the main service equipment and at the secondary terminals of transformers creating separately derived distribution systems such as dry-type transformers.

3.2 EQUIPMENT GROUNDING SYSTEM

A. General: Provide a complete equipment grounding system in accordance with the minimum code requirements and as further indicated on the drawings or specified. The equipment ground (green conductor) consists of metallic connections to ground of non-current carrying metal parts of the wiring system or apparatus connected to the system. The primary purpose of equipment grounding is to provide greater safety by limiting the electrical potential between non-current carrying parts of the system and to provide a low impedance path to ground for possible ground fault currents.

B. Common Ground Point: Establish one common ground point as specified elsewhere in this section of the specifications for interconnection of the equipment grounding system and the service grounding electrode conductor.

C. Service Equipment Enclosure: Bond the enclosure of the main service equipment to the uninsulated equipment ground bus (or bar) with a conductor or bar sized for 25% of the largest service overcurrent device.

D. Ground Bar: Provide an uninsulated equipment ground bar, separate from any insulated neutral bar, in all switchboards, panelboards, transformers, motor control centers, starters, disconnect switches, cabinets, etc. for grounding the

enclosure and for connecting other equipment ground conductors. The ground bar shall be an integrally mounted and braced bus bar in switchboards or a separately mounted bar adequately braced or bolted to the enclosure of other types of equipment. The ground bar shall be adequately braced or bolted to the enclosure after thoroughly cleaning both surfaces to ensure good contact. Provide solderless pressure connectors for all conductor terminations. Number and size of pressure connectors on equipment grounding bars as required for the termination of equipment grounding conductors. In addition to the active circuits, provide pressure connectors for all three-phase spares and spaces.

E. Conduits: Where metallic conduits terminate without mechanical connection to a metallic housing of electrical equipment by means of lock nut and bushings, provide ground bushing connected with a bare copper conductor to the ground bar in the electrical equipment. Metallic conduits containing ground wiring only shall be bonded to the ground wire at both conduit entrance and exit. Install grounding conductor in each nonmetallic conduit or duct except those used for telephone, sound, or low-voltage signals and in all flexible conduit that does not have a built-in ground conductor. Bond the conductor at both ends to the equipment grounding system.

F. Feeders and Branch Circuits: Provide a separate green insulated equipment grounding conductor for each single or three-phase feeder and each branch circuit with a three-phase protective device. Provide a separate green insulated equipment grounding conductor for single phase branch circuits unless otherwise indicated. Install the required grounding conductor in the common conduit or raceway with the related phase and/or neutral conductors and connect to the box or cabinet grounding terminal. Where there are parallel feeders installed in more than one raceway each raceway shall have a green insulated equipment ground conductor.

G. Devices: Install a minimum No. 12 green insulated equipment bonding conductor from a grounding terminal in the respective outlet or junction box to the green ground terminal of all receptacles and through flexible conduit to all light fixture housings.

H. Motors: Install a separate green insulated equipment grounding conductor from the equipment ground bar in the motor control center of separate starter through the conduit and flexible conduit to the ground terminal in the connection box mounted on the motor. Install the grounding conductor in the common conduit or raceway with the related motor circuit conductors.

3.3 SEPARATELY DERIVED SYSTEMS

A. Transformers creating separately derived distribution systems, such as dry-type transformers, shall utilize the equipment ground bars in the transformer enclosure for both secondary equipment ground and secondary neutral ground with separate grounding conductor extended to an approved ground electrode.

3.4 GROUNDING ELECTRODE SYSTEM

A. A minimum of two service ground electrodes shall be utilized. One shall be the main cold water metallic water piping system and the other shall be a made

electrode consisting of not less than twenty feet of bare copper conductor encased along the bottom of a concrete foundation footing which is in direct contact with the earth. Make the connections to the cold water pipe inside the building at the point of entrance. Other grounding electrodes (building steel, ground counterpoise, etc.) shall be bonded to the grounding electrode system where utilized. The grounding electrode for separately derived systems shall be approved for the application.

3.5 GROUNDING CONDUCTORS

A. The grounding electrode conductors for the service grounding electrode system shall be insulated or bare copper, sized in accordance with NEC, including the conductor for the supplemental electrodes. The conductors shall be continuous without joint or splice and shall be installed in conduit with the conduit bonded to the conductor at each end. Install the conductor to permit the shortest and most direct path and terminate in the main service equipment on the common ground point. Equipment grounding conductors shall be green insulated conductors equivalent to the insulation on the associated phase conductor. The equipment grounding conductor or straps shall be sized in accordance with NEC. Where one feeder serves a series of panelboards or transformers, the equipment grounding conductor shall be continuous without splices. Grounding conductors shall not be installed through metal-sheathed holes. All connections shall be available for inspection and maintenance.

3.6 GROUND CONNECTIONS

A. Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated the coating must be removed down to the bare metal. After the coating has been removed apply a non-corrosive approved compound to cleaned surface and install lugs or clamps. Where galvanizing is removed from metal it shall be painted or touched up with "Galvanox", or equal.

B. All grounding connections to bare stranded wire, ground rods, etc. shall be BURNDY HY-GROUND™ or approved equivalent or approved exothermic connection method. All connectors shall meet the requirements of IEEE STD 837 (Latest Revision), “IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding”. All connectors must be listed by Underwriters Laboratories for direct burial in earth or embedment in concrete applications according to ANSI/UL-467 (latest revision), “Standard for Grounding and Bonding Equipment.” Connectors must be suitable for lightning protection applications. Listing to UL-96 “Lightning Protection Components” preferred on applicable items.

3.7 TESTS

A. Test the completed grounding system with a megger at the service ground bar and submit a written report to the Architect/Engineer for approval. The service shall not be energized if the test shows more than 5 ohms, unless approved by the Architect/Engineer.

END OF SECTION

SECTION 26 0533
RACEWAYS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install complete conduit systems for the various electrical systems required for this project. Systems shall be complete with supports, mounting devices, pull boxes, etc., as required for installation of wiring systems and terminal devices.

1.3 RELATED WORK IN OTHER SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of Division 26 Sections apply to this Section when applicable.

PART 2 - PRODUCTS

2.1 CONDUITS

A. Steel Conduit: Rigid, threaded, thick wall, hot dipped galvanized.

B. Electrical Metallic Tubing (EMT): Mild steel, zinc coated on the outside and either zinc coated or coated with an approved corrosion resistant coating on the inside. Maximum size 2-inch electrical trade size unless noted on the drawings or specifically approved.

C. Intermediate Metal Conduit (IMC): Rigid, threaded, lightweight steel, zinc-coated on the outside and either zinc-coated or coated with an approved corrosion resistant coating on the inside.

D. Flexible Conduit: Commercial "Greenfield," galvanized steel, with a separate grounding bond wire installed in the conduit in addition to other wires.

E. Liquid Tight Flexible Conduit: Flexible galvanized steel tubing with extruded liquid tight PVC outer jacket and a continuous copper bonding conductor wound spirally between the convolutions. Where a separate grounding conductor is installed in the conduit, bonding conductor in the convolutions may be omitted.

F. Plastic coated rigid steel conduit shall be hot dipped galvanized steel conduit with a coating of polyvinyl chloride, minimum 15 mills (0.015), on the exterior surfaces, shall have an approved corrosion resistant coat inside. To be Pittsburgh, J & L, Republic or approved equal.

G. Rigid Non-Metallic Conduit: Schedule 40, high impact PVC with 7,000 psi tensile strength at 73.4 degrees F., 11,000 psi flexural strength, 8,600 psi compression strength, approved for 90-degree C. conductors. Carlon, triangle, or approved equal. PVC conduits shall include a ground wire sized as noted or as required by NEC (whichever is larger). No bends shall be made in PVC. Rigid galvanized steel conduit shall be utilized for all elbows, risers and bends.

H. Aluminum Conduit: Shall not be used unless specifically indicated on the drawings for specialized purposes.

I. Conduit Size: Minimum conduit size, 1/2 inch except where specifically approved for equipment connections. Sizes not noted on drawings shall be as required by the NEC. All homeruns to panels shall be 3/4 inch minimum.

2.2 CONDUIT FITTINGS

A. Connectors and Couplings: Compression type threadless fittings for rigid steel conduit or IMC not permitted. EMT couplings and connectors either steel or malleable iron only, "Concrete Tight" or "Raintight" and either the gland and ring compression type or the stainless steel multiple point locking type. Connectors to have insulated throats. EMT fittings using set screws or indentations as a means of attachment on conduits 2” or larger are not permitted.

B. All conduits shall terminate in bushings or connectors which are insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system.

C. Rigid Steel Conduit, IMC and EMT Fittings: Iron or steel only.

D. Liquid Tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon or equal plastic compression ring and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without "O" ring seat. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit, or other equipment to which it is connected.

E. Rigid Aluminum Conduit Fittings: Malleable iron, steel, or aluminum alloy. Ferrous fittings zinc coated or cadmium plated. Aluminum alloy fittings shall conform with the characteristics defined by UL for aluminum rigid metallic conduit and shall not contain more than 0.04 percent copper.

F. Flexible Conduit Fittings (Commercial Greenfield): Either steel or malleable iron only, with insulated throats and shall be one of the following types:

1. Wedge and screw type with angular wedge fitting between the convolutions of the conduit.

2. Squeeze or clamp type with bearing surface contoured to wrap around the conduit and clamped by one or more screws.

3. Steel, multiple point type, for threading into internal wall of the conduit convolutions.

G. Expansion Fittings: Each conduit that is buried in or rigidly secured to the building construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings shall be hot dipped galvanized malleable iron with factory installed packing and a grounding ring.

H. Sealing Fittings: Threaded, zinc or cadmium plated, cast or malleable iron type for steel conduits and threaded cast aluminum type for aluminum conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

I. Fittings for PVC Coated Rigid Steel Conduit: Ells and couplings used with PVC coated rigid steel conduit shall have a factory applied coating of polyvinyl chloride, minimum 15 mills (0.015) on exterior surfaces and shall have a PVC sleeve extruded a minimum of 2" from one end of the fitting.

2.3 WIREWAYS

A. Square-D Company Square-Duct (or equal) "lay-in" type without knockouts with lengths and fittings hinged to provide an unobstructed wireway to "lay-in" conductors. Use standard lengths. Field cuts permitted where absolutely necessary. Rust inhibiting phosphatizing coating on sheet metal parts. Blue gray baked enamel finish. Hardware plated to prevent corrosion. Provide all accessories, including tee fittings, junction boxes, cross fittings, transposition section, gusset brackets, nipples, pull boxes, reducer fittings, wall flanges, panel or cabinet flanges, elbows, ceiling and wall support brackets and supporting hardware, etc.

2.4 OUTLET BOXES

A. Construction: Zinc coated or cadmium plated steel boxes of a class to satisfy the condition at each outlet except where unilet or condulet bodies are required. Knockout type with knockouts removed only where necessary to accommodate the conduit entering. Square cornered, straight sided gang boxes, 4-inch octagon concrete rings and 4-inch octagon hung ceiling boxes with bars may be folded type. One piece deep drawn type for all other boxes.

B. Size: To accommodate the required number and sizes of conduits, wires and splices in accordance with NEC requirements, but not smaller than size shown or specified. Standard concrete type boxes not to exceed 6 inches deep except where necessary to permit entrance of conduits into side of boxes without interference with reinforcing bars. Special purpose boxes shall be sized for the device or application indicated.

C. Fixture Studs: 3/8-inch malleable iron fixture stud in outlet boxes for ceiling lighting fixtures and interior bracket lighting fixtures, other than lamp receptacles and drop cords.

D. Exposed: Screw joint type, with gasketed weatherproof covers in locations exposed to the weather. Shall be of the continuous drain type. Where required to be "Raintite."

E. Tile Boxes: Rectangular in shape with square corners and straight sides for receptacles and switches mounted in furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls. Install without plaster rings.

F. Wall Mounted Switch, Receptacle and Signal Boxes: Unless otherwise noted or specified, not less than 4 inches square by 1-1/2 inches deep for single devices, 4-11/16 inches by 1-1/2 inches deep for two devices and multi gang boxes for more than two devices. Boxes for switches and receptacles on unfinished walls may be screw joint type with covers to fit the devices. Provide plaster rings, as required, to provide proper opening for device.

G. Wall Mounted Telephone Outlet Boxes: 4-11/16 inches square by 2-1/8 inches deep, unless otherwise noted on the drawings.

H. Light Fixture Boxes: 4-inch diameter by 1.5-inch-deep minimum for ceiling and interior bracket fixtures with concealed conduits. Plaster covers for bracket fixtures to have 3-inch diameter openings. Screw joint boxes with canopy seat for ceiling and interior bracket fixtures with exposed conduits.

I. Grounding Terminal: Provide a grounding terminal in each box with circuits serving motor driven equipment or receptacles for grounding to a green equipment ground conductor. Grounding terminal shall be green colored washer-in-head machine screw.

2.5 PULLBOXES

A. Minimum NEC requirements unless larger box is noted. As specified for outlet boxes with blank cover for pullboxes with internal volume not more than 150 cubic inches. As specified for cabinets for pullboxes with internal volume over 150 cubic inches, except covers to have same thickness as box with corrosion resistant screw or bolt attachment.

2.6 FLOOR BOXES

A. Heavy duty, cast, adjustable type, suitable for the device or application indicated, unless noted otherwise or prior approved. Provide carpet flanges in carpet areas.

B. Fire-Rated Poke-Throughs (FRPT): Poke-Through, fire rated, style boxes shall be utilized for floor assemblies above grade meeting the floor assembly rating. Any penetrations shall be coordinated with the structural engineer of record.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

A. Conduit Systems: Conduit shall be provided for all wiring circuits. Material shall be exposed or concealed as required by the Drawings. Rigid Steel conduit, IMC,

EMT or Rigid Non-Metallic conduit unless noted. Install rigid steel conduits for underground runs, when specifically noted on the drawings, runs in concrete, feeder circuits and where required by the NEC for mechanical protection, etc. Use flexible conduit only for equipment connections and then only to the extent of minimum lengths required for connections (Typically 1'-0", maximum length 4'-0"). Install flexible conduit connections at all resilient mounted equipment. Provide liquid tight flexible conduit in exterior, wet or damp locations and for connections to all motors, dry type transformers and wet pipe mechanical systems. Aluminum conduit may be used only if specifically called for. Conduit and tubing shall be kept at least 6 inches from parallel runs of hot water or steam pipes. PVC conduit may be used only for runs below grade or in slab. Concrete encasement is required under all paved areas. Rigid steel, galvanized elbows shall be used for all bends and risers. No PVC shall be extended above grade or slab. Ground wires, sized in accordance with NEC, shall be installed in all conduit runs, except where used for telephone conductors.

B. Conduit Installation: Install concealed conduit and EMT in as direct lines as possible. Install exposed conduits and EMT parallel to or at right angles to the lines of the building. Right angle bends in exposed conduit and EMT runs shall be made with standard elbows, screw jointed conduit fittings or conduit bent to radii no less than those of standard elbows. Exposed conduits below the five (5) foot level shall be galvanized rigid conduit.

C. Concealed Conduits: Install conduit systems concealed where possible unless otherwise noted. Conduit systems may be exposed in unfinished utility areas, ceiling cavities and where specifically approved by the Engineer. No conduit shall be run on roof or exposed face of building unless specifically shown on plans or prior approved by all of the Owner/Architect/Engineer.

D. Conduit in Concrete: Conduits shall not be installed in floor slabs poured on grade. Conduits under slab shall be installed a minimum 6” below slab, covered with earth. PVC coated rigid steel conduit may be embedded in above grade concrete providing the outside diameter does not exceed 1/3 thickness of concrete slab, wall or beam, is located entirely within the center third of the member and lateral spacing of conduit is not less than 3 diameters.

E. Conduit in Ground: PVC schedule 40 non-metallic conduit may be utilized for all underground runs unless noted otherwise on the drawings. Installation and use of PVC shall comply with NEC. All conduit sizes, shown on the plans, shall be increased to accommodate the installation of the equipment grounding conductor. All joints shall be made with solvent cement per manufacturer's recommendations and shall be watertight. PVS schedule 40 plastic conduit runs shall not be stubbed up above grade, and shall be converted to PVC schedule 80 or PVC Plastoid coated rigid steel conduit by installing a female adapter, 90-degree PVC coated rigid steel elbow and a PVC coated rigid steel nipple of length as required to stub conduit up. Plastic conduit shall be used for straight runs only. PVC coated rigid steel conduit shall be used for all bends, ells and offsets. Where rigid galvanized steel conduit is in contact with dirt, soil, fill or earth, conduits shall be field wrapped with one layer of 3M Scotch 50 plastic tape with a 50% overlap, including all joints or couplings, or shall be coated with a bonded, 20 mil minimum thickness PVC, permanently fused at the factory, or

approved equal. An equipment grounding conductor, in accordance with NEC, shall be installed in all conduits. Minimum burial depth of conduits or ducts shall be as follows:

Power: Primary (above 600v.), 42" unless encased in concrete or specified otherwise by serving utility.

Secondary (below 600v.), 36" unless encased in concrete.

Telephone: 24" unless encased in concrete or specified otherwise by serving utility.

F. Conduit Bends: In any conduit or EMT run, the number of quarter bends or equivalent between termination's at cabinets or boxes shall not exceed four bends. Bends in telephone and data conduits shall be long sweeping bends.

G. Conduit Openings: Protect all vertical runs of conduits or EMT terminating in the bottoms of boxes or cabinets, etc., from the entrance of foreign material prior to installation of conductors.

H. Roof Penetrations: All roof penetrations shall be sealed as called for in the architectural plans and specifications.

I. Pull Cords: The Contractor shall furnish and install a full length, 3/32" nylon pull cord in every "empty" conduit installed hereunder to facilitate the future installation of wires. Identify each terminus of pull wire with linen tags with complete information as to service and location of the terminus of the cord.

J. Sealing Fittings: Install where required by the NEC, where conduits pass from warm to cold locations and where otherwise indicated.

K. Sleeves for Conduit: Install sleeves for conduit where shown or as required. Conduit sleeves not used shall be plugged with recessed type plugs. Sleeve all conduit passing through walls. Sleeves that are used shall be caulked tight with an approved means to meet the assembly characteristics.

L. Identification: Identify all exposed raceways according to the system carried. Identify exposed conduits by an approved means. Provide legible lettering in contrasting colors. Abbreviate only when approved. Identification shall be placed at maximum intervals of twenty feet on straight conduit runs, close to all terminations, adjacent to all change in directions and where conduits pass through walls or floors.

3.2 CONDUIT SUPPORTS

A. Supports: Provide supports for horizontal conduits and EMT not more than 8 feet apart with not less than two supports for each 10-foot straight length and one support near each elbow or bend including runs above suspended ceilings and within 3 feet of all junction boxes, switches, fittings, etc.

B. Straps: Install one hole pipe straps on conduits 1.5 inch or smaller. Install individual pipe hangers for conduits larger than 1.5 inch. Spring steel fasteners with hanger rods may be used in dry locations in lieu of pipe straps.

C. Trapezes: Install multiple (trapeze) pipe hangers where two or more horizontal conduits or EMT run parallel and at the same elevation. Secure each conduit or EMT to the horizontal hanger member by a U-bolt, one hole strap or other specially designed and approved fastener.

D. Hanger Rods: Install 1/4-inch diameter or larger galvanized steel rods for trapezes, spring steel fasteners, clips and clamps. Wire or perforated strapping shall not be used for the support of any conduit or EMT.

E. Fastening: Fasten pipe straps and hanger rods to concrete by means of inserts or expansion bolts to brickwork by means of expansion bolts and to hollow masonry by means of toggle bolts. Wooden plugs and shield shall not be used. Power driven fasteners may be used to attach pipe straps and hanger rods to concrete only where approved by the Engineer.

F. All conduits not embedded in concrete shall be firmly secured by means of pipe clamps, hangers, etc., equal to Caddy fasteners of ERICO Products, Inc. Wire wrapped around conduits and supporting members will not be accepted.

G. On Roof: All conduits laid on roof shall be supported by an approved means utilizing a UL listed product for the purpose.

H. Lay-in Ceiling: Conduits routed above acoustical "lay-in" ceilings shall be anchored to the building structure and not laid on the ceiling. Wire shall not be used to anchor boxes to structure. If ceiling support system is adequate, one 3/4" maximum conduit may be supported by a Caddy Clip to an identified hanger wire. Multiple runs of conduit shall be racked on trapeze hanger. All support materials shall be rustproof. Perforated tape or soft iron wire shall not be used.

3.3 CONDUIT STUB-UPS

A. Conduits run under floor shall be stubbed up to a coupling set flush with floor. This excludes conduits stubbed up in walls and feeder conduits. Install flush plug until after floor is finished, then complete connections to boxes or equipment.

3.4 OUTLET BOXES

A. Outlet Boxes: Outlet boxes, covers and fittings, according to the particular use for which they are required, shall be provided in the locations marked on the drawings by symbols, and/or for use to facilitate the installation of the electrical systems. When necessary, outlets shall be relocated so that when fixtures of other fittings are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment required by the drawings and/or specifications.

B. Installation: Unless otherwise specified or shown on the drawings, outlet boxes shall be flush mounted and the front edges of the boxes or plaster covers shall

be flush with the finished wall or ceiling line or if installed in walls and ceilings of incombustible construction, not more than 1/4 inch back of same. Mount boxes with the long axes of devices vertical, unless otherwise specified. Boxes in plastered walls and ceilings shall be provided with plastic covers. A multiple of box extensions and/or covers will not be permitted. Install in a rigid and satisfactory manner with suitable metal bar hangers, box cleats, adjustable box hangers, etc. Use wood screws on wood, expansion shields on masonry and machine screws on steel work.

C. Mounting Heights: The mounting height of a wall mounted outlet box shall be construed to mean the height from the finished floor to the horizontal center line of the cover plate. On exposed tile, block or brick construction, mount outlet boxes at the nearest bed joint to the mounting height indicated. Wall Mounted Switch, Receptacle and Signal Outlets: On columns, pilasters, etc., mount so the centers of the columns are clear for future installation of partitions. Install outlet boxes near doors or windows close to trim. Install outlet boxes near the doors on the lock sides (see architectural drawings for correct door swings).

D. Identification: Identify all exposed junction boxes according to the system carried by an approved means with legible letters and contrasting colors and without abbreviations.

3.5 PULLBOXES

A. Provide additional pullboxes wherever necessary to meet requirements for maximum length of conduit runs and maximum numbers of bends.

3.6 FLOOR BOXES

A. Install level with top covers adjusted flush with finished floor or floor tile.

3.7 FIXTURE CONNECTIONS

A. Recessed or surface light fixtures in lay-in or accessible ceilings shall be connected with flexible metallic conduit, 4 to 6 feet long with grounding provisions.

3.8 CLOSING OF OPENINGS

A. Wherever slots, sleeves or other openings are provided in floors or walls for the passage of conduits or other forms of raceway, such openings, if unused, or the spaces left in such openings, shall be filled, or closed in an approved manner.

3.9 IDENTIFICATION

A. Refer to Section 26 0500 - GENERAL ELECTRICAL PROVISIONS for identification requirements for raceways and boxes.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Underground warning tape.

1.2 RELATED SECTIONS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of Division 26 Sections apply to this Section when applicable.

1.3 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Latest Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. NFPA 70E - Standard for Electrical Safety in the Workplace; latest edition.

1.4 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
   a) Panelboards:
      1) Identify voltage and phase.
      2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
4) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

b) Transformers:
1) Identify power source and circuit number. Include location when not within sight of equipment.

c) Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.

d) Enclosed Contactors:
1) Identify voltage and phase.
2) Identify load(s) and associated circuits controlled. Include location.

2. Service Equipment:
a) Use identification nameplate to identify each service disconnecting means.
b) For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
c) Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.

3. Emergency System Equipment:
a) Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
b) Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

4. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less as follows:
a) The phasing of all conductors (#6 and larger) shall be identified by color coding tape. Conductors sizes #8 and smaller shall have colored insulation. The grounded (neutral) conductor sizes #6 and smaller shall be white or light gray or have 3 continuous white stripes on other than green insulation. Grounded (neutral) conductors larger than size #6 shall be color coded white with coding tape. Grounding conductors sizes #6 and smaller shall

have green insulation or be bare the entire length. Grounding conductors larger that size #6 shall be color coded green with coding tape.

2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premise has feeders or branch circuits served by more than one nominal voltage system.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

2. Use voltage markers or color-coded boxes to identify systems other than normal power system.
   a) Color-Coded Boxes: Field-painted per the same color code used for raceways.
      1) Fire Alarm System: Red.

E. Communication Cabinets: Nameplates.

F. Control Device Station: Labels.

G. Electrical Distribution and Control Equipment Enclosures: Nameplates.

H. Junction Box Load Connections: Wire markers.

2.2 MANUFACTURERS

A. Brady Corporation: www.bradycorp.com.

B. Other approved manufacturer(s) authorized by the engineer of record.

2.3 IDENTIFICATION NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background, unless indicated otherwise for nameplates for Essential Power System equipment.

1. Engraving stock shall be melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.

2. Nameplates and labels shall have punched or drilled holes for mechanical fasteners.

3. Nameplates and labels shall be fastened using self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts with flat and lock washers.

B. Locations:

1. Each electrical distribution (distribution panels and panelboards) and control equipment enclosure.

2. Communication cabinets.

3. All special systems cabinets.

C. Letter Size:

1. Use 1/8-inch letters for identifying individual equipment and loads.

2. Use 1/4-inch letters for identifying grouped equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations, and identified specialized power devices.

2.4 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Legend: Power source and circuit number or other designation indicated.

C. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

D. Minimum Text Height: 1/8 inch.

E. Color: Black text on white background unless otherwise indicated.

F. Description: Vinyl cloth type self-adhesive wire markers.

G. Locations: Each conductor at panelboard gutters, pull boxes, and junction boxes each load connection.

2.5 UNDERGROUND WARNING TAPE

A. 4" Polyethylene tape, Foil-backed Detectable Type Colored Red Tape: 4" inches wide, with minimum thickness of 4 mil, with suitable warning legend describing buried systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

A. Install line marker for underground wiring, both direct buried cables and cables in raceway.

B. Paint fire alarm junction boxes red.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout.

D. Electrical Gear and Equipment Identification Labels: Engraved plastic laminate shall be installed on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch-high label. Where two lines of text are required, use labels that are 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of electrical gear and equipment using mechanical fasteners:

1. Interior and exterior of distribution panelboards, panelboards, electrical cabinets, enclosures, and other equipment.
   a) Main Overcurrent Protection: Identify main device and service disconnects.
   b) Distribution Panelboards: Identify Distribution Panelboard designation and circuit serving distribution panelboard. Label main and distribution overcurrent protection showing load served and location (identify room numbers, where possible).
   c) Branch Panelboards: Identify distribution panel and circuit serving panelboard.
   d) Disconnect Switches: Identify equipment designation, voltage and horsepower rating or full-load current capacity.
   e) Enclosed Circuit Breakers: Identify equipment designation, voltage, and full-load current capacity.
   f) Motor Starters: Identify equipment designation, voltage and horsepower rating or full-load current capacity.
   g) Power Transfer Equipment (Manual and Automatic): Identify equipment designation, power sources, voltage, and full-load current capacity.

2. Identification Labels for Other Electrical Equipment: Engraved plastic laminate shall be installed on each unit of equipment. Unless otherwise indicated, provide a single line of text with 1/2-inch-high lettering on 1-1/2-inch-high label. Where two lines of text are required, use labels that are 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of electrical gear and equipment using mechanical fasteners:
   a) Transformers.
   b) Lighting contactors.

c) Push-button stations and other control stations or devices.
d) Telephone switching equipment.
e) TV/audio-monitoring master station.
f) Fire alarm system master station or control panel.
g) Fire alarm system extender or battery panel.
h) Security-monitoring master station or control panel.

E. Provide framed, typed circuit schedules for all panelboards with explicit description and identification of items controlled by each individual circuit breaker.

1. Panelboards: Identify existing circuits as well as new circuits with new, typed circuit schedules.
   a) 208 Volt System: Black
   b) Other Special Systems: Yellow.

F. Circuit Identification Labels: Provide external labels for all installed device face covers and junction boxes prior to installation of conductors. Circuit identification shall be as shown below.

1. Labeling Legend for Junction Boxes: Provide permanent, waterproof label listing panel and circuit number.

2. Labeling Legend for Device Face Covers in Patient Care Areas, as defined by NEC Article 517: Provide permanent, adhesive label listing the panel and circuit number.

3. Circuit Identification Labels on Cover or Face Plates: Install labels externally for all installed wiring device plates indicating panel and circuit number.
   a) Clear preprinted adhesive labels.

G. Color-Coding for Secondary Phase Conductors: Color code switch legs, travelers, and other wiring for branch circuits other than those listed below. Permanently post color code at each branch panelboard. Use the following colors for service, feeder, and branch-circuit phase conductors:

1. 208/120-Volt, 3-Phase System Conductors:
   a) Phase A: Black.
   b) Phase B: Red.
   c) Phase C: Blue.
   d) Neutral (Common): White.
   e) Ground (Earth): Green.

H. Circuits Operating at More Than 600 Volts: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot (3-m) intervals over a continuous, painted orange background. Identify the following:

1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to conduits concealed within wall.

3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.

4. Entire surface of exposed conduits.

END OF SECTION

SECTION 26 2726
WIRING DEVICES AND PLATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions for the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install all wiring devices and plates as required for the complete installation and operation of all systems throughout the project.

1.3 RELATED WORK IN OTHER SECTIONS

A. Conductors, Conduit, Boxes and Fittings.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Unless otherwise specified, each wall switch (flush tumbler-toggle) shall be of the A.C. General use type for mounting in a single gang spacing, fully rated 20 amperes minimum at 120/277 volts, conforming to minimum requirements of the latest revision of the Underwriter's Laboratories, Inc., UL 20 Fifth Edition Standard Snap Switches and further requirements herein specified. Specification grade, heavy duty, single pole, 3-way or 4-way, of the maintained, momentary or lock type as indicated on the drawings. Switches shall operate in any position and shall be fully enclosed cup type with entire body of molded phenolic, urea or melamine with cover of molded phenolic, urea or melamine. Fiber, paper, or similar insulating material shall not be used for body or cover. Ivory color handles unless otherwise indicated. Silver or silver alloy contacts. A.C. 120/277 volt general use snap switches shall be capable of withstanding tests as outlined in NEMA Publications and shall be as follows unless otherwise noted:

Switch	Hubbell	P & S	Bryant	Leviton
1P	1221-I	20-AC-1-I	4901-I	1221-I
2P	1222-1	20-AC-2-I	4902-I	1222-I
3-Way	1223-I	20-AC-3-I	4903-I	1223-I
4-Way	1224-I	20-AC-4-I	4904-I	1224-I
3-pos. 2 cct maintained	1385-I	1225-I	4922-I	
3-pos. 2 cct momentary	1557-I	1251-I	4921-I	
Lighted handle pilot lgt.	1221-PL	2251-SP	4901-PL	1220-PL

2.2 RECEPTACLES

A. General: Configuration and requirements for all connector or outlet receptacles shall be in accordance with NEMA Publications. Fire resistant, non absorptive, hot welded, phenolic composition or equal bodies and bases with metal plaster ears (integral with the supporting member). Single or duplex as shown or noted on drawings. Ivory color unless otherwise noted on the drawings. Double grip contacts for each prong.

B. Grounding Type: All receptacles shall be grounding type with a green colored hexagonal equipment ground screw of adequate size to accommodate an insulated grounding jumper (based on Table 250-95 of the NEC with minimum size No. 14 AWG). Grounding terminals of all receptacles shall be internally connected to the receptacle mounting yoke. Unless otherwise noted, receptacles shall be as follows:

Receptacle	Hubbell	P & S	Bryant
20A-125V AC 2P 3W	5362-I	6300-I	5362-I
20A-208V AC 4P 4W	7250	7250	7250
30A-250V AC 3P 3W	9350	L1030R	9303
30A-600V AC 4P 4W	3430	3430	3430
20A-125V GFCI	GFRST20W	PT2097TRW	GFRST20W
20A-125V GFCI /ALARM	GFRST20WB	2097TRAW	GFRST20WB
Special	Receptacles for special applications shall be as indicated on the drawings.		

C. Load Controllable Type:

1. Meet all aspects already detailed in specifications.

2. Permanent controlled markings on face of receptacle compliant with ASHRAE 90.1, CA Title 24, and NEC.

3. Half-controlled versions include welded, pre-wired lead that control top half of receptacle for split circuit applications.

4. Refer to plans for specific model and control options.

2.3 PLUG CAPS

A. Except for duplex receptacles, and cleaning combination receptacles one matching plug cap shall be provided for each receptacle. No plug caps are required for duplex receptacles. Provide watertight, male plug caps in damp locations or where exposed to weather.

2.4 DEVICE PLATES

A. General: Provide plates for each switch, receptacle, signal and telephone outlet and special purpose outlet. Do not use sectional gang plates. Provide multi gang outlet plates for multi gang boxes. All plates on finished walls shall be Leviton #84000-40 series, stainless steel. Screws shall be of metal with countersunk heads with finish to match the finish of the plate. Device plates shall be of the one-piece type, of suitable shape for the device to be covered.

B. Exposed: Plates for exposed screw jointed fittings shall match the fittings with edges of plates flush with edges of fittings. To be heavy cadmium plates, steel, with gasket. Plates for cast type boxes at locations subject to wet or rain conditions, shall be of the cast, vapor tight type. Provide hinged lift covers for devices.

C. Communications: Plates for telephone and signal outlets shall each have a 3/8-inch bushed opening in the center. Wall plates for push button and buzzer outlets shall have openings to suit the push buttons and buzzers.

D. Plates for special purpose outlets shall be of a design suitable for the particular application.

PART 3 - EXECUTION

3.1 OUTLET LOCATIONS

A. Shall be as indicated on the drawings. Align devices and plates horizontally and vertically.

B. It shall be the responsibility of the Contractor to determine from the architectural drawings and by actual determination on the site, the exact location of each and every outlet. The outlet locations shall be modified from those shown on the plans to accommodate changes in door swings or to clear other interferences that may arise from job construction details as well as modifications within room spaces. These modifications shall be made with no change in contract price and shall be a matter of job coordination at the expense of the Contractor. The Contractor shall check these conditions throughout the entire job and shall notify the Architect/Engineer of discrepancies as they occur before proceeding with the installation of the work to verify the modifications, if any. Wall boxes shall be set in advance of wall construction, shall be blocked in place and secured. All wall boxes shall be set flush with finished building construction and the Contractor shall furnish and install extension sleeves as required to extend boxes to the finished surfaces of special furring. No switches shall be located behind doors without specific written authorization by the Architect.

3.2 YOKES

A. Wiring device yokes shall be installed in physical contact with the plaster ring. Where the above contact cannot be obtained, a green covered bonding conductor shall be installed.

3.3 PLATES

A. Shall be installed with all four edges in continuous contact with finished wall surface without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16".

B. Device cover plates for each and every device shall be furnished and installed by this Contractor.

3.4 RECEPTACLES

A. Shall have a separate ground wire from the grounding screw to a grounding stud in the outlet box. All receptacles shall be installed with the "U" slot in the upper position. Substitutions for duplex convenience outlets as listed in 262726 - 2.2 shall only be considered if rated as “Specification Grade”.

END OF SECTION

SECTION 26 2800
MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install complete motor and circuit disconnects for various items requiring them for this project.

1.3 RELATED WORK IN OTHER SECTIONS

A. Conductors, motors, motor starters, motor control centers, panelboards, grounding.

PART 2 - PRODUCTS

2.1 DISCONNECTING MEANS

A. Safety Switches: Fusible Type HD quick break safety switches of the sizes and capacities indicated or required. NEMA 4 Raintight enclosures at locations exposed to the weather.

B. Separately Enclosed Motor Snap Switches: Motor snap switches may be used for motor disconnect means, controller and motor overcurrent protection when applicable. These devices shall be horsepower rated and shall contain motor running overcurrent protection.

2.2 SAFETY TYPE DISCONNECTING SWITCHES

A. Heavy duty, quick make, quick break type, 250, 480 or 600 volt rating as required for the application. Number of poles and ampacity as noted or required for application, or required by code. Fusible with fuse clips suitable for Buss fuses. Short circuit rating of 200,000 RMS Amperes with Class R rejection feature installed in fuseholders. NEMA 1 enclosures for dry locations. NEMA 4 enclosures for wet locations or where exposed to weather unless otherwise noted.

B. Fuses shall be provided for all switches. Fuses for switches at motors shall be Bussman Fusetrons, sized for heavy service motor running protection. Fuses in other locations shall be as designated on the drawings or indicated in Section 262813 of these specifications. Proper fuse amp ratings shall be indicated on inside of switch cover, through the use of "Tapewriter" and should read "Use Fusetrons Only" (indicate amperage size as shown on plans). See Section 26 2813 - FUSES for other labeling requirements.

PART 3 - EXECUTION

3.1 DISCONNECT MEANS

A. Install in each location indicated on the drawings and elsewhere as required by NEC.

B. Switches installed outdoors shall be raintight and shall be suitably supported, independently of the item to be served (by unistrut rack) unless sufficient unobstructed flat surface exists on the unit to properly support the electrical equipment.

C. Coordinate installation of elevator electrical connections with elevator supplier and local codes.

END OF SECTION

SECTION 26 2813
FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish and install all fuses required for the various electrical systems required for this project.

1.3 RELATED WORK IN OTHER SECTIONS

A. Panelboards, motor control centers, motor and circuit disconnects.

PART 2 - PRODUCTS

2.1 FUSES

A. General: Dual element, time delay type, based on heavy service, Buss Fusetron, or equal, unless otherwise noted or required for installation. For individual motor circuit protection, provide fuse sized approximately 125 percent of full load current with 200,000 amperes interrupting capacity.

B. Current-Limiting Fuses: Provide where indicated on the drawings. For non-motor feeder protection in conjunction with fused switches, install NEMA Class L or K Buss Limitron fuses sized 125 percent of load current or as required for coordination with air and molded case circuit breakers.

1. Above 600 amps: Class L, "Hi-Cap" as manufactured by Bussman.

2. Below 600 amps, as required by short circuit duty, Class RK-1, "Limitron" or Class RK-1, "Low Peak" or Class RK-5, "Fusetron" as manufactured by Bussman.

3. All switches having current limiting fuses installed shall have a Lamicoid nameplate with white lettering on red background reading:

   WARNING, REPLACE ONLY WITH CURRENT
   LIMITING FUSES AS ORIGINALLY INSTALLED

C. All fuses shall be rated 200,000 AIC and be of the rejection feature type.

2.2 COORDINATION

A. Coordinate the low voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

2.3 FUSE CABINET

A. Provide one wall mounted cabinet for storing all spare fuses. The cabinet shall have a hinged door with latch, with the word "FUSES" stenciled on the front.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate the low voltage fuses required for the project to provide basic selective protection and properly coordinate with the other associated protective equipment.

3.2 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SPARE FUSES

A. Furnish one complete spare set (3) of each size and type of fuse required on this project for panelboards, safety switches, and switchboards. Deliver to Owner in the original boxes and store in the fuse cabinet furnished under this Contract.

END OF SECTION

SECTION 26 5119
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 Conform with applicable provisions of the General Conditions, Supplementary Conditions and General Requirements.

1.2 RELATED WORK IN OTHER SECIONS

26 0500	GENERAL ELECTRICAL PROVISIONS
26 0519	LOW VOLTAGE CONDUCTORS
26 0526	GROUNDING
26 0533	RACEWAYS, BOXES, AND FITTINGS
26 2726	WIRING DEVICES AND PLATES

1.3 SECTION INCLUDES:

A. Interior solid-state luminaires that use LED technology.

B. Lighting fixture supports.

C. Construction and installation requirements.

1.4 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See “Luminaire”.

D. IP: International Protection of Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.5 SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Product Schedule: For luminaires and lamps. Use same designation indicated on Drawings.

C. Refer to Section 26 0500 for additional requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product Certificates: For each type of luminaire.

C. Sample warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Recessed Fixtures: Comply with NEMA LE 4.

C. CRI and CCT shall be as scheduled on contract documents.

D. Rated lamp life of 50,000 hours.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

G. Nominal Operating Voltage: as specified on the drawings.

H. Housings:

1. Extruded-aluminum housing and heat sink.

2. Clear powder-coat finish.

3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Prismatic acrylic.

2. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

3. Lens thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.

2. Clear powder-coat finish.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems” for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: ½-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length. Brace to limit sway or swinging.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging or sway.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.

2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

L. Comply with requirements in Division 26 for Power Conductors and Cables for wiring connections.

J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 for Identification for Electrical Systems.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare Test and inspection reports.

END OF SECTION

SECTION 27 0000
COMMUNICATIONS INDEX

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. All bids shall be based on the equipment as specified herein. The specifying authority must approve any alternate system.

B. Bidders wishing to submit alternate equipment shall submit to the specifying authority, at least 10 days prior to bid opening, the equipment proposed to provide a precise functional equivalent system to meet specifications. Bidder shall provide adequate information prior to bid date such as specification sheets, working drawings, shop drawings, and a demonstration of the system. Alternate supplier-contractor must also provide a list to include six installations of the identical system proposed which have been in operation for a period of two years.

C. Final approval of the alternate system shall be determined at the time of job completion. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate system at the contractor's expense.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of Division 26 Sections apply to this Section when applicable.

1.3 COMMUNICATIONS DIVISION INDEX

270500	COMMON WORK RESULTS FOR COMMUNICATIONS
270526	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
270528.2	PATHWAYS

PART 2 - PRODUCTS (Not used.)

PART 3 - EXECUTION (Not used.)

END OF SECTION

SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

A. The Contractor is held responsible to be familiar with the provisions of all contract division contained herein and with other Sections of these Specifications as applicable to the completion of the installation of all communication systems as indicated in the contract documents. The Contractor is held responsible to be familiar with the requirements contained herein and shall possess the knowledge, manpower, and material applied to the completion of the installation.

B. This section describes the installation locations for the products and materials, as well as methods and specification standards associated with the Information Technologies installation portions of the project. These specifications, along with the drawings shall be followed during the construction and installation of all Division 22 systems.

C. The contractor is required to be currently listed as a registered Manufacturer Certified Installer and Warranty Provider of the products to be installed.

D. Contractors shall provide all labor personnel for cabling and infrastructure installations who are trained and certified by the manufacturer in the installation of the submitted products, and requirements of this document.

1.1 SCOPE OF WORK

A. Work covered by this Section shall consist of furnishing labor, equipment, supplies, materials, and testing unless otherwise specified, and in performing the following operations recognized as necessary for the construction, installation, termination, testing, and labeling of all information technology infrastructure as described on the drawings and/or required by these specifications.

B. The Contractor is required to be knowledgeable in all of the related sections contained within the specifications standards to ensure that common work results are achieved.

C. In addition to the installation and construction requirements of these documents, all project-related design and construction shall meet the requirements of the contract documents.

1.2 RELATED SECTIONS

Division 26 Electrical
Division 27 Communications
Division 28 Electronic Safety and Security

Any CSI Division that impacts Division 27 Specifications

1.3 INTENT OF DRAWINGS AND SPECIFICATIONS

A. These Specifications and Drawings shall depict the Information Technology infrastructure and cabling requirements for installation. Contractors shall furnish labor and material shown and/or called for on the Drawing but not mentioned in the Specifications, or vice/versa, that are necessary for the installation and support of communications cabling whether or not specifically called for in both documents. In addition, the Contractor shall provide incidental equipment and material required for the completion of systems included in this contract whether or not specified or shown on the drawings.

1.4 ACRONYMS

A. **AFF** Above Finished Floor

B. **ARCH** Architectural

C. **MEP** Mechanical, Electrical, Plumbing

D. **CAT** Category

E. **CATV** Cable Television

F. **ER** Equipment Room

G. **EMI** Electromagnetic Interference

H. **F/UTP** Foiled Shield Twisted Pair

I. **MH** Maintenance Hole

J. **IT** Information Technology

K. **PB** Pull Box

L. **PP** Pull Point

M. **TGB** Telecommunications Grounding Busbar

N. **TMGB** Telecommunications Main Grounding Busbar

O. **TR** Telecommunications Room

P. **PBX** Private Branch Exchange (Phone Switch)

Q. **UTP** Unshielded Twisted Pair

R. **WAP** Wireless Access Point

The BICSI Telecommunications Manuals are available as references for additional definitions and acronyms.

1.5 REFERENCES ORGANIZATIONS

A. The following organizations publish telecommunications construction standards with provisions that, through reference in this text, constitute provisions of this specification:

1. Building Industry Consulting Services International (BICSI)
2. Telecommunications Industry Association (TIA)
3. Electronic Industry Alliance (EIA)
4. National Electrical Code (NEC)
5. National Electrical Safety Code (NESC)
6. National Fire Prevention Association (NFPA)
7. American National Standard Institute (ANSI)

1.6 STANDARDS AND REFERENCES

A. The following list of methods and standards included in the References Organizations are considered part of the requirements of this specification. This is a list of primary references and does not limit the applicability of other standards that are incorporated into the list of References Organizations applicable to the work described in these practices, described in Standards documents (and addenda) published by recognized standard bodies and organizations. All references listed are considered to be of the latest edition printed. These include standards published by the Telecommunications Industry Association / Electronics Industries Alliance (TIA/EIA) and Building Industry Consultant Services International (BICSI).

1. BICSI TDMM and Specialty Manuals, Building Industry Consultant Services International, *Telecommunications Distribution Methods Manual*.
2. ANSI/TIA/EIA 568, *Commercial Building Telecommunications Cabling Standard.*
3. ANSI/TIA-568-C.0-2009+A1:2010+A2:2012, *Generic Telecommunications Cabling for Customer Premises.*
4. ANSI/TIA-568-C.2–2009+A1:2010, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard*
5. ANSI/TIA-568-C.3–2009+A1:2011, *Optical Fiber Cabling Components Standard.*
6. ANSI/TIA-568-C.4–2011, *Broadband Coaxial Cabling and Components Standard.*

7. ANSI/TIA/EIA 569, *Telecommunications Standard for Pathways and Spaces.*

8. ANSI/TIA/EIA 607, *Commercial Building Grounding and Bonding Requirement.*

9. ANSI/TIA/EIA 758, BICSI *Customer-Owned Outside Plant Telecommunications Cabling Standard.*

10. ANSI/TIA/EIA 862 *Building Automation Systems Cabling Standard Cabling for Commercial Buildings.*

11. ANSI/NFPA 70, National Electrical Code, (NEC).

12. TIA-526-7 (OFSTP-7)-2002+A1:2008, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.*

13. TIA-526-14-B-2010 (OFSTP-14), *Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement*.

14. Building Industries Consulting Services International (BICSI) *Telecommunications Distribution Methods Manual* (TDMM).

PART 2 - PRODUCTS

2.1 PRODUCTS STANDARD

A. All materials shall conform to the currently applicable industry standard including, but not limited to:

1. Electronic Industries Alliance (EIA)

2. American National Standard Institute (ANSI)

3. National Electrical Manufactures' Association (NEMA)

4. American Society for Testing and Materials (ASTM)

5. Insulated Cable Engineers Association (ICEA)

6. Institute of Electrical and Electronic Engineers (IEEE)

7. National Electrical Safety Code (NESC)

B. In addition, all material shall be Underwrites Laboratories Listed unless otherwise indicated.

C. The approved product manufacturers are listed as an Appendix to this specification.

D. All products shall be new.

E. Products substitutions shall be managed according to the following guidelines:

1. All product submittals shall be approved by the Architect or Engineer before purchasing by the Contractor.

2. Where specified only by reference standard, select any approved product meeting standard of the manufacturer.

3. Where specified by naming several products or manufacturers, select any product and manufacture named in this Standard Specification.

4. Where specified by naming one or more products or manufacturers, but indicating “or approved equivalent” after the specified listing, the specified product is the preferred quality standard. The Contractor shall submit a request for the equivalent product for approval.

5. Where specified by naming only one product and manufacture: There is no option and no substitutions that will be allowed without prior approval.

6. Submit requests for substitution within 10 days of contract award, or sooner if required to maintain the construction schedule.

7. The Contractor must submit sufficient information to show that a proposed substitute is equivalent to the item specified.

8. Acceptance of substitutions is at the discretion of the Architect or Engineer. The Architect or Engineer reserve the right to determine the suitability of the substitute product and reject any material submitted for substitution.

9. All substituted products and materials must be approved for substitution by the Architect or Engineer in writing before installation.

10. Products rejected or otherwise judged unsatisfactory by the Architect or Engineer will not be authorized for use in completing the work. Any unapproved products discovered as part of the installation will be removed by the Contractor and replaced with specified and approved products at the Contractor’s expense.

11. Project Drawings may be based on the equipment configuration of a particular manufacturer. If a substitution is approved, the Contractor shall make changes needed to accommodate the substitution at no expense to the project, including work under other divisions.

PART 3 - EXECUTION

3.1 IT INSTALLATION

A. Each Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate common work results with all trades.

B. The Contractor shall be responsible for furnishing all materials on the drawings, specifications,- and addendums as specified herein for a complete IT system.

C. All IT infrastructures shall be installed in a “workmanlike manner” acceptable to the Architect and Engineer; any work not acceptable to the Architect and Engineer shall be removed and installed at Contractor’s expense.

D. All work shall be completed in a “workmanlike manner” as specified by the NFPA standards.

E. All work by the Contractor must comply with applicable standard listed in this Specification.

F. The contractor is required to provide all drawings and obtain all permits from the proper jurisdiction for all work associated with this specification.

G. All IT infrastructures shall be installed to ensure optimal performance.

H. All existing and new IT infrastructure shall be installed to accommodate new work and modifications.

I. All work performed in occupied space shall be in a manner that allows the Owner to operate the existing facilities continuously.

J. All work that will affect the user connectivity, including wireless access points, shall be submitted for approval to the Owner two weeks before starting.

K. New Telecommunication Rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic.

L. The contractor shall provide a Manufacturer’s Warranty of not less than 20 years on the structured cabling systems and components.

M. All work by the contractor must comply with the manufacturer’s product-recommended installation and warranty requirements.

N. The Contractor shall provide all redlines, station documentation, and test results two weeks before substantial completion or end user move-in, whichever is first.

O. The Contractor shall abide by all work rules, safety and security requirements, schedules, and other requirements established by the General Contractor related to the work area or project.

3.2 SCHEDULES

A. Information Technologies (IT) Milestones shall be included and updated in all project schedules. Updates for these IT Milestones shall be provided at all construction meetings.

B. An IT project schedule shall be provided and approved by the Owner before the commencement of any work.

C. The Contractor is responsible for scheduling inspections with UNM IT which are required after the following milestones but not limited to:

1. Pathways and Electrical Rough-in before covering (In-wall/Ceilings/Floors).

2. IT room Rough-in.

3. IT room to build out (i.e., Cable tray, grounding, equipment racks, sleeves, firestop systems, power, etc.).

4. Cable installation.

5. Cable termination.

6. Labeling.

7. Testing.

8. IT punch list.

9. Final acceptance.

3.3 DELIVERABLES TO OWNER IT

A. IT Subcontractor (before start)

1. Qualifications

2. Certifications

B. Product Submittals, including specification data, prior to purchase.

C. Schedules including timelines and milestones before starting any work and updated when changed.

D. Test Results. (after testing and a minimum of 2 weeks to planned activation)

E. Telecommunications Outlet Numbering Plan/Intra Building Numbering Sheets (IBNS) and a copy of the working as-built drawings. (after testing and a minimum of 2 weeks before planned activation).

F. Final As-built Drawings shall be delivered to the Architect and Engineer two weeks after occupancy in both hard and electronic format. Any new outside plant or specified project as-built drawings require AutoCAD update.

PART 4 – APPENDIX FOR APPROVED PARTS LIST

4.1 The following table lists the most commonly used components of the AMP NetConnect Category 6 & 6A copper horizontal cabling system, Corning Cable Systems LANscape fiber backbone system, and Chatsworth Products ladder rack, racks, cable mangers and grounding components. These systems contain too many parts to list them all in this

document. Consult the manufacturer's websites for the most current item descriptions and part numbers. Any substitutions must be approved by ICT.

4.2 **ATTENTION ELECTRICIANS, TELECOMMUNICATIONS, AND FURNITURE CONTRACTORS**

A. Modular furniture, tombstones, poke-throughs, and in-floor boxes will require careful consideration when purchasing these items. Not all bezels are compatible with AMP NetConnect modular jacks. Do not install incompatible fixtures where telecommunications outlets are required.

AMP NetConnect	
620 Series, Category 6 UTP Cable, CMR, Blue	TE620P-BL RB
620 Series, Category 6 UTP Cable, CMR, White	TE620P-WT RB
620 Series, Category 6 UTP Cable, CMP, Blue	TE620R-BL RB
620 Series, Category 6 UTP Cable, CMP, White	TE620R-WT RB
640 Series, Category 6A U/UTP Twisted Pair Cable, CMR, Blue	TE640P-BL 02
640 Series, Category 6A U/UTP Twisted Pair Cable, CMR, White	TE640P-WT 02
640 Series, Category 6A U/UTP Twisted Pair Cable, CMP, Blue	TE640R-BL 02
640 Series, Category 6A U/UTP Twisted Pair Cable, CMP, White	TE640R-WT 02
Category 6A, 48 Port, Angled Patch Panel	2111573-1
Category 6A, Modular Jack, Orange	1933476-5
Category 6A, Modular Jack, Blue	1933476-6
Category 6A, Modular Jack, Black	1933476-2
Category 6A, Modular Jack, Yellow	1933476-8
Category 6A, Modular Jack, Green	1933476-9
Category 6, 48 Port, Angled Patch Panel	1375015-2
Category 6 Modular Jack, Orange	1375055-5
Category 6 Modular Jack, Blue	1375055-6
Category 6 Modular Jack, Yellow	1375055-8
Category 6 Modular Jack, Black	1375055-2
Category 6 Modular Jack, Green	1375055-9
SL Series Multimedia Inserts, Almond	Various
Faceplate 4-Port, SG, Almond	558088-1
Faceplate 2-Port, SG, Almond	557505-1
Faceplate 4-Port, DG, Almond	83935-1
Corning LANscape	
Fiber Fan Out Kit 12 Pos/25	FAN-BT 25-12
Wall Mount Housing F-12 WCH-12P	WCH-12P
6P Panel Rack CCH SC SM CCH-CP12-59	CCH-CP12-59
LANscape Wall Mount Splice Housing WSH-16SPT	WSH-16SPT
Splice Protection Heat Shrink (pkg-50)	2806031-01
Unicam ST MM 95-000-50	95-000-50
Fiber 48F SM LT Altos	048EU4-T 4701D20
24/96-F Rack Mount Enclosure CCH-02U	CCH-02U

12/48-F Rack Mount Enclosure	CCH-01U
Fiber 48-F MIC SM Plenum	048E88-61131-29
Connector Splice Housing CSH-05U	CSH-05U
SM / MM Splice Tray M67-048	M67-048
Corning Splice Tray/12 - M67-060	M67-060
Fiber Enclosure BGE LANScape EDC-06P-NH	EDC-06P-NH
Wall Mount Splice Cabinet WCH-SSH-4-12	WCH-SSH-4-12
Wall Mount Connector Housing WCH-04P	WCH-04P
Closet Connector Housing, 12 Panel	CCH-04U
FUSELITE SC SM BLUE PRE-POLISHED FERRULE	AS236342
Fiber 96F SM Altos	096EU4-T 4101D20
MIC SM PVC Fiber Optic cable	012E81-33131-24
Fiber Clean Wipes	FC-45-1
Chatsworth Products Inc.	
UNIVE RSAL CABLE RUNWAY, Black, 12 inch wide	10250-712
Butt-Splice Kit, Black 16301-701	
Intelligent Fan Kit, For ThinLine II Wall-Mount Cabinet	13051-001
G3 Double -Side d Cable Managers	35523-701
G3 Combination Vertical Cable Managers	35573-701
Universal Rack, 7' high, 19", Black	46353-701
Evolution Horizontal Cable Manager, 2U, Black	35441-700
ThinLine II Wall-Mount Cabinet, Beige	13050-222
Intelligent Fan Kit, For ThinLine II Wall-Mount Cabinet	13051-000
G3 Double-Sided Cable Managers	35523-702
G3 Combination Vertical Cable Managers	35573-702
Universal Rack, 7' high, 19", Black	46352-702
Evolution Horizontal Cable Manager, 2U, Black	35441-701
ThinLine II Wall-Mount Cabinet, Beige	13050-223
Intelligent Fan Kit, For ThinLine II Wall-Mount Cabinet	13051-001
G3 Double-Sided Cable Managers	35523-703
G3 Combination Vertical Cable Managers	35573-703
Universal Rack, 7' high, 19", Black	46352-703
Evolution Horizontal Cable Manager, 2U, Black	35441-702

END OF SECTION

SECTION 27 0526
GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor is held responsible to be familiar with the provisions contained herein and with other Sections of this Specification as applicable to the completion of the installation. The Contractor is held responsible to be familiar with the provisions contained herein and is assumed to possess the knowledge, manpower, and materials necessary for the completion of the installation.

B. Work covered by this Section shall consist of furnishing all labor, equipment, supplies, materials, and testing otherwise specified, and performing the following operations recognized as necessary for the complete installation, termination, and labeling of ground and bonding infrastructure as described on the Drawing and /or required by these specifications.

C. Listed manufacturers and products are required. UNM IT Networks approved equivalent products and systems are also acceptable with the prior written approval of submittals.

1.2 RELATED SECTIONS

A. Division 26 - Electrical Division

B. Division 27 - Communicants Systems.

C. Division 28 - Electronic Safety and Security

PART 2 - PRODUCTS

2.1 GROUNDING BUSBARS

A. Telecommunications Grounding Main Grounding Busbar (TMGB).

1. Predrilled, copper, non-anodized BICSI/TIA/EIA/ANSI approved (4”W **x** 1/4”H **x** 12”L) ground bus bar with insulators and standoffs. (Chatsworth 40153-012 or UNM IT approved equivalent)

B. Telecommunications Grounding Busbar (TGB)

1. Predrilled, copper, non-anodized BICSI/TIA/EIA/ANSI approved (2”W **x** 1/4”H **x** 12”L) ground bus bar with insulators and standoffs. (Chatsworth 13622-012 or UNM IT approved equivalent)

2.2 GROUNDING JOINTS AND SPLICES

A. Grounding conductor joints/ splices shall be mechanical type, copper alloy, with a minimum of two bolts and a spade section for each conductor.

B. Grounding conductor terminations (lugs) shall be a single barrel, mechanical screw type, copper alloy with machined contact surfaces.

2.3 BONDING CONDUCTORS

A. Cable Tray Bonding Conductor.

1. Green # 6 AWG insulated bonding jumper with appropriate lugs or manufactured braided copper grounding jumper.

B. Equipment Fame Bonding Conductor.

1. Chatsworth TRGK672 Telecommunications Rack Grounding Kit or Owner IT approved equivalent.

C. Bonding Conductor (BC)

1. Green insulated copper bonding conductor, size as required by NEC.

2. The BC shall be, as a minimum the same as the TBB.

D. Telecommunications Bonding Backbone (TBB)

1. Green insulated copper conductor, a minimum size of #6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/) AWG Insulation shall meet fire ratings of its pathway or be in conduit.

SEE TABLE 1 BELOW

TABLE 1			
Sizing of Telecommunication Bonding Backbone (TBB)			
TBB length FT	Grounding Conductor Size (AWG)	DC Resistance Per 100 Ft (Copper Conductor)	Short-Time Rating (A)
< 13 Ft	6	0.0491	621
14 - 20 Ft	4	0.0308	988
21 - 26 Ft	3	0.0245	1245
27 - 33 Ft	2	0.194	1571
34 - 41 Ft	1	0.0154	1981
42 - 52 Ft	1/O	0.0122	2499
53 - 66 Ft	2/O	0.00967	3150
> 66 FT	3/O	0.00766	3972
	4/O	0.00608	5008
	kcmil		
	250	0.00515	5917
	300	0.00429	7101
	350	0.00367	8284
	400	0.00321	9467

	500	0.00258	11834
	AWG = American Wire Gauge		
	DC = Direct Current		
	kcmil = Thousand circular mils		

PART 3 - EXECUTION

3.1 TELECOMMUNICATIONS INSTALLATION

A. Bonding and grounding all conduits, cable trays, enclosures, cables, protectors, and other conductive infrastructure as per the requirements of the NEC and TIA 607 to main building ground.

1. Nonconductive coatings (such as paint, lacquer, and enamel) on equipment to be grounded shall be removed from threads and other contact surfaces to ensure good electrical continuity or be connected utilizing fittings designed to make such removal unnecessary.

B. Installation of the TMGB in ER/TR.

1. Install the TMGB at the bottom of the plywood backboard near the entrance conduits within the ER/TR Room.

2. TMGB shall be installed so that the BC is as short and straight as possible, with the proper bend radius.

3. The BC shall be a green insulated conductor installed exposed per Table 1.

4. Connection at TMGB from the main electrical service ground shall be installed to meet NEC 250.94 and TIA/EIA requirements type. Ground resistance shall not exceed 2 ohms unless approved by the Architect or Engineer.

5. Busbar shall be predrilled for future connections. (Chatsworth 40153-012 or approved equal.)

6. Provide a label (Do Not Disconnect) on the connection to the main electrical service ground.

C. Installation of TGB in TR.

1. Install the TGB at the bottom of the plywood backboard near the copper riser terminations within the UNM IT Telecommunications Space.

2. TGB shall be installed so that the TBB for telecommunications is as short and straight as possible, with the proper bend radius.

3. The BC shall be Green insulated conductor sized from Table 1.

4. Busbar shall be predrilled for future connections. (Chatsworth 13622-012 or approved equal.)

D. Installation of the TBB.

1. Installation mechanical type, copper alloy, with a minimum of two bolts and separate sections for each conductor or copper compression type with two (2) indents

E. Installation of Grounding Conductor Joints/Splices.

1. Install manufactured insulating cover or heavy tape insulation over joints/splices.

F. Grounding of Cable Tray/Ladder Rack/Basket Tray

1. Install Green #6 AWG bonding jumper (12 inches max) with appropriate lugs at each cable tray joint or install a manufactured braid copper grounding jumper. In place of bonding jumpers, use manufactures approved grounding type connectors to connect sections of cable trays will be permitted.

2. Install Green #6 AWG grounding conductor with appropriate lugs from the side of the cable tray down to TMGB or TGB. Drill the side of the cable tray and install a ¼" fine thread appropriate length bolt, making sure that the bolt does extend into the wire management part of the tray.

G. Ground of Equipment Frame.

1. Install Telecommunications Rack Grounding Kit approved by the Architect or Engineer, from equipment frame to ground cable tray, TMGB or TGB.

H. Grounding of Telecommunications Duct banks.

1. Provide a continuous # 4/0 bare-stranded copper conductor within the concrete at the bottom of all Duct banks. Terminate the bonding ribbon in telecommunications maintenance holes.

I. Grounding of Telecommunications Maintenance Holes and Handholes.

1. Provide bonding jumper to reinforcing steel in each section.

2. Install a bonding ribbon horizontally around the bottom of each maintenance hole and attached it to all the cable racks and metallic hardware within the maintenance hole. Continue installation vertically between the bonding clamps so both the top and bottom halves are bonded together on each side. (The bonding ribbon will be used to bond and ground all future splice cases and hardware placed within the maintenance hole).

3. Provide a ground rod near a corner within 6" of the corner in each maintenance hole and handhole. Bond to the ribbon in the maintenance hole.

END OF SECTION

SECTION 27 0528.2
PATHWAYS

PART 1 - GENERAL

A. The Contractor is responsible to be knowledgeable with provisions contained herein and with other Sections of this Specification as applicable to the work related to this section.

1.1 SCOPE OF WORK

A. The scope of work under this section consists of providing conduits, boxes, raceways, pathways, and cable supports for telecommunications wiring included in this project.

B. Work covered by this Section shall consist of furnishing all labor, equipment, supplies, and material, unless otherwise specified, and performing the following operations are necessary for the installation and testing of all infrastructure required by this specification's standard.

C. The horizontal infrastructure begins in the telecommunications room (TR) and is terminated at the telecommunications outlet that is located in the end user work area.

D. Only the Architect/Engineer or Owner-approved manufacturers for structured cabling systems shall be installed in the pathways. The exact Category performance requirements are project specific. Verify and comply with manufacturer installation and warranty requirements when designing and installing structured cabling systems.

E. The typical Telecommunications Outlet is a Category 6 faceplate that shall be provisioned to accept four (4) ports. The standard installation is two (2) Category 6 cables and two (2) 8P8C jacks. There will be applications where other cabling requirements are needed. When these cables are added to the Telecommunications Outlet such as (Category 6, 6A, F/UTP Fiber, or Coax) use approved jacks. The sizing of the pathway will need to be adjusted to meet additional cabling requirements. Initial installation shall have a 40% fill rate.

F. Provide conduits and boxes for Code Blue Emergency Phones, Elevator Phones, mechanical and electrical metering equipment, and wall phones.

G. Furnish and install an inter-building cabling infrastructure and pathways. Originate the system from the building's main equipment room and distribute it to the telecommunications room.

H. Furnish and install raceways and cable tray systems in hallways and other accessible areas, above ceilings where applicable or as specified in the project documents and drawings.

I. Transition cable tray to conduit systems in inaccessible areas. Must meet the same volume as the tray.

J. Install cable tray and raceway systems according to the manufacturers' product installation instructions using the manufacturers' approved methods and components.

K. Furnish, install, and document re-enterable UL-listed firestop assemblies at all firewall penetrations. (Architect or Engineer-approved firestop systems are Hilti and/or STI.) Document means the manufactures label is permanently attached to the wall located adjacent to the penetration along with a photo taken and submitted to Owner.

1.2 RELATED SECTIONS

A. Division 26 Electrical Division

B. Division 27 Communicants Systems.

C. Division 28 Electronic Safety and Security

1.3 RELATED REFERENCES

A. All work performed under this section must comply with the manufacturer's approved methods and comply with the most recent versions of the following Industry Standards and Practices applicable to work being performed under this section. The contractor shall have working knowledge and possess the following documents of the Standards and Methods listed and must adhere to the most recent published edition.

1. National Fire Protection Association

2. National Electrical Code

3. National Electrical Safety Code

4. Telecommunications Industry Association (including but not limited to)
   a) TIA/EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces.
   b) TIA/EIA 758 3Customer-Owned Outside Plant Telecommunications Cabling Standard.
   c) TIA/EIA 568 Commercial Building Telecommunications Cabling Standard
   d) TIA/EIA 607 Grounding

5. Building Industry Consulting International (BICSI)
   a) Telecommunications Distribution Design Manual

PART 2 - PRODUCTS

2.1 TELECOMMUNICATIONS OUTLETS BOXES, FLOOR BOXES and SURFACE RACEWAYS

A. Telecommunication Outlets shall have the ability to accommodate a complete line of connectivity modules including those for UTP cables Category 6, Category 6

Augmented F/UTP, fiber optic, coaxial, and other cabling types with matching faceplates and bezels to facilitate mounting.

1. It is the responsibility of the project RCDD, Electrical Engineer and Contractor to verify that the design requirements which are specified below have been met.

2. It is the responsibility of the contractor to submit an RFI for any noted incorrect designs or conditions found that do not meet the requirements of this Specification Standard.

B. Furnish and install telecommunications outlets in studded drywall or masonry wall providing a 4 11/16” inch square 2 1/8” inch deep boxes with 1” inch mud ring provisioned with a 1” inch conduit knockouts. The box depth will be 3 1/8” inches. It is the responsibility of the designer, electrical contractor, and structured cabling contractor to identify and verify the conduit and box size to match the cabling requirements at each location.

1. Fiber Optic, Category 6, and Category 6 Augmented F/UTP radius: The depth of the box shall accommodate a 1 ¼” inch cable bend radius, which meets or exceeds the specifications for fiber optic and UTP cabling per TIA/EIA-56 requirements for communications pathway. A 1 ¼” inch-controlled radius storage loop shall be installed.

C. The minimum requirement for all telecommunications outlets is 0.75” and a 1” inch conduit(s) as depicted on the drawing(s) provisioned with a bushing on each and a measured pulled line secured at each termination point for horizontal cabling installation. The conduit sizing and fill ratio shall be verified in design and provided to meet the requirements of the TIA/EIA 568, 569 with an initial installation fill ratio of 40% percent. Alternative pathway restrictions or allowances shall be approved by the Owner in writing prior to commencing the project.

D. For all horizontal cabling pathways provide a minimum of a 1” inch conduit from the outlet box to the nearest cable tray or conduit system. Terminate conduits above cable trays at approximately 12 inches to the nearest side rail.

E. In inaccessible as well as areas that are non-adjacent to spaces conduit shall be provided from the outlet box to the nearest cable tray or conduit system with no exceptions. Terminate conduits above cable trays at approximately 12” inches to the nearest side rail.

PART 3 - INTRA BUILDING INFRASTRUCTURE

3.1 GENERAL REQUIREMENTS

A. The intra-building pathways intend to provide the building with a route from the building’s ER/TRs and spaces to the TOs at the end user’s work area or equipment termination point.

B. The installation of new pathways shall not interfere with existing utilities or pathways. The contractor shall coordinate the installation of the new pathways with other trades and project requirements. Minimum clearances shall be 6” inches on sides 3 inches below and 12” inches above.

C. All pathways must remain accessible and useable after completion.

D. All pathways must comply with the list of related references listed in Part 1 of this section and comply with installation instructions and methods specified by the product manufacturer.

E. The contractor shall reference the related sections listed in Part 1 to determine any additional requirements necessary to complete the project.

3.2 TELECOMMUNICATIONS OUTLETS

A. New construction telecommunications outlets shall be installed at a minimum of 18” inches AFF unless specified.

B. The telecommunications outlet box will be a 4-11/16” inch square box with a 1” extension ring fitted with a single gang mud plate.

C. The telecommunications outlet shall be provisioned minimum with a 1” inch EMT conduit that has bushings installed and a measured pull line installed and secured at the conduits terminations points.

D. Telecommunications outlets are not to be installed back-to-back.

E. Firestop the outlet box using a listed UL application in firewalls.

F. Renovated Areas of Existing Buildings Alternate – When approved by the Architect or Engineer.

1. In accessible ceiling areas, extend the conduit through the wall plate and bend the conduit 90º to face the nearest cable tray, or access conduit or sleeve.

G. Provide a minimum of one (1) 2” inch EMT sleeve on non-rated walls from the cable tray into each room. On fire-rated walls use Architect or Engineer-approved firestop sleeve as per 2.11 Firestop. In inaccessible or semi-accessible ceiling areas, install a complete 1” inch minimum EMT conduit system from the telecommunications outlet box to the nearest or most available cable tray.

H. Install system Category-compliant cable supports every 36” to 60” inches.

I. Conduit needs to run in the most direct route possible, parallel with building lines and in a workman-like manner.

J. The use of flexible metallic conduit is not permitted.

K. Specify UL-listed fire-stopping application for conduit and sleeve penetrations using a code-compliant and re-enterable application as per 2.11 Firestop. Document and provide to the owner a photo of the application, the name of the listed application, the date of installation, and the name of the installer.

3.3 GENERAL CONDUIT REQUIREMENTS

A. Horizontal conduit routes are to be designed to enable the cabling system to meet the link length requirements of 295 feet.

B. Intra-building conduit runs shall contain no continuous sections longer than 100 feet. If runs total more than 100 feet, pull points or pull boxes shall be inserted.

C. Conduit shall have no more than 180 degrees of cumulative bends between pull points or more than 90 degrees of bends at any one point.

D. The use of a third conduit bend is only acceptable if:

1. The total conduit run does not exceed 33’ feet.

2. The conduit is increased to the next trade size.

3. One of the bends is located within 12” inches of the cable feed end.

E. Pull boxes are not to be used as a means to change the direction of conduit runs. Pull boxes are to be sized as per the latest version of the BICSI TDMM.

F. The use of EB’s is not permitted. Only approver LB type bodies that are manufacturers for the use with communications cabling.

G. Specify UL listed fire-stopping application for conduit and sleeve penetrations using a code-compliant application in the fire-stopping section. Install a Hilti or STI UL compliant and re-enterable application as per 2.11 Firestop. Document and provide to the owner a photo of the application, the name of the listed application, the date of installation, and the name of the installer.

H. The following table provides general guidelines for cable capacity for conduits that have no more than two 90º bends and are not longer than 100 feet. It is based on a maximum 40% fill and includes a de-rating factor of 15 % for each of the two 90º bends. The final conduit design shall be compliant with the Related References in Part 1. The radius of conduit bends shall be at least 10 times the conduit diameter. Under certain conditions where 10 times bend radius is not achievable due to structural conditions 6 times bend radius may be permitted by Owner.

Table 1 – Maximum Conduit Fill for Horizontal Cables Number of Cables or Wires

Wire O.D. mm	3.3	4.6	5.6	6.1	7.4	7.9	9.4	13.5
(in)	(.13)	(.18)	(.22)	(.24)	(.29)	(.31)	(.37)	(.53)
Conduit size								
1	8	8	7	6	3	3	2	1
1 ¼	16	14	12	10	6	4	3	1
1 ½	20	18	16	15	7	6	4	2
2	30	26	22	20	14	12	7	4
2 ½	45	40	6	30	17	14	12	6

3	70	60	50	40	20	20	17	7
3 ½	-	-	-	-	-	-	22	12
4	-	-	-	-	-	-	30	14

Note: Ensure that conduit/sleeve cable fill does not exceed specified fire-stopping methods.

3.4 JUNCTION BOX REQUIREMENTS FOR STATION CONDUITS

A. If the station conduit route exceeds the 180º of total bends limitation, an appropriately sized junction box is required within a straight section of the conduit run.

B. A junction box shall not be used in place of a bend. All junction boxes in station conduit paths shall be installed within a straight section of the conduit run.

C. Junction Box Requirements for Station Cables.

JUNCTION BOX REQUIREMENTS FOR STATION CONDUITS			
Conduit Size	Size of Box		
	Width	Length	Depth
¾”	4”	4”	3.5”
1”	4-11/16”	4-11/16”	3.5”
1 ¼”	6”	6”	4”
1 ½”	6”	6”	4”
2”	8”	8”	4”
2 ¼”	12”	12”	6”
2 ½”	12”	12”	6”

D. Telecommunications pathways requiring fire-stopping shall utilize UL-listed re-enterable fire-stopping assemblies. See Section 2.11 Firestop (Hilti, STI, or Wiremold).

E. In all buildings, floor/ceiling assemblies, stairs, and elevator penetrations shall be sealed with a 2-hour fire stop assembly at a minimum, unless otherwise noted.

F. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction. Fire-rated construction is to be verified with Owner. All fire-stopping penetrations must be photographed and labeled with the UL1479 or ASTM E814 reference number, dated, and signed by the technician who installed the fire-stopping material. Submit firestop documentation to the Architect or Engineer before the final electrical inspection.

END OF SECTION

SECTION 28 0000
ELECTRONIC SAFETY AND SECURITY INDEX

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

A. Furnish all labor, equipment, materials, service tools, etc., which are required for the complete installation of all Electronic Safety and Security work, as indicated on the Drawings and specified herein. Electronic Safety and Security work indicated on the Drawings and/or specifications covering other trades shall conform to Division 28 of these Specifications.

B. Work or equipment not indicated or specified, which is necessary for the complete and proper operation of the Electronic Safety and Security systems, shall be accomplished without additional cost to the Owner.

1.3 ELECTRONIC SAFETY AND SECURITY DIVISION INDEX

28 0500	GENERAL ELECTRONIC SAFETY AND SECURITY PROVISIONS
28 3000	FIRE ALARM SYSTEM

PART 2 - PRODUCTS (Not used.)

PART 3 - EXECUTION (Not used.)

END OF SECTION

SECTION 28 0500
GENERAL ELECTRONIC SAFETY AND SECURITY PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General Special Conditions and the General Requirements, apply to the work specified in this section.

1.2 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

A. Regulatory Agencies: Installation, materials, equipment and workmanship shall conform to the applicable provisions of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), Occupational Safety and Health Act (OSHA) all local, state and national codes, ordinances and regulations governing the particular class of work involved and the terms and conditions of the electrical utility and other authorities having lawful jurisdiction pertaining to the work required. All modifications required by these codes, rules, regulations and authorities shall be made by the Contractor without additional charge to the Owner. The Contractor shall secure all permits and licenses required for their work and shall pay all fees in connection with such permits and licenses.

B. On completion of the various parts of the work, the installation shall be tested by the constituted authorities and approved; and, on completion of the work, the Contractor shall obtain and deliver to the Owner, final certificates of acceptance. The Contractor shall furnish copies of each certificate to the Architect/Engineer.

C. Underwriter's Laboratories (UL): All materials, appliances, equipment or devices shall conform to the applicable standards of Underwriter's Laboratories, Inc. where such standards have been established.

D. Standards: The current edition of the following specifications and standards shall form a part of these specifications:

1. National Fire Protection Association Standards
2. National Electrical Code, NFPA 70 (NEC)
3. Life Safety Code, NFPA 101
4. NFPA 72
5. Occupational Safety and Health Act (OSHA)
6. National Electrical Safety Code (NESC)
7. Underwriter's Laboratories, Inc. (Standards)
8. American National Standards Institute (ANSI)
9. American Society of Testing and Materials (ASTM)

10. Institute of Electrical and Electronic Engineers (IEEE)

11. Insulated Cable Engineer's Association (ICEA)

12. National Electrical Manufacturer's Association (NEMA)

13. Americans with disabilities Act Accessibility Guidelines (ADA)

1.3 DRAWINGS

A. The electrical drawings show the general arrangement of all conduit, outlets, equipment, etc. and shall be followed as closely as actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as a part of the work insofar as these drawings furnish the Contractor with information relating to the design and construction of the building. Architectural drawings shall take precedence over electrical drawings. Because of the small scale of the electrical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange their work accordingly, providing such fittings, elbow, pullboxes, and accessories as may be required to meet such conditions.

B. The Contractor shall verify the dimensions governing the electrical work at the building. No extra compensation shall be claimed or allowed because of differences between actual dimensions and those indicated on the drawings.

C. Drawings and specifications shall be considered as complementary. Work or materials called for by one and not mentioned in other shall be provided as though treated by both.

D. In the case of conflict between drawings and specifications, the greater or more restrictive requirement shall apply.

E. Any question as to the intent of the drawings or specifications shall be referred to the Architect/Engineer, whose decision shall be final and conclusive.

F. Should the Contractor observe any conflict or variation in the plans and specifications, they shall notify the Architect/Engineer in writing no later than seven (7) days prior to date of bid opening. Failure to clarify such variations will result in the Contractor bearing all costs arising from electrical work necessary to resolve the conflict or variation.

1.4 AS-BUILT DRAWINGS

A. During progress of the work, the contractor shall maintain an accurate record of the installation of the system, locating each outlet, and note all circuiting deviations from the contract drawings. Upon completion of the installation, the contractor shall transfer all record data to a single neat and legible set of blue line prints of the original drawings.

1.5 OPERATING INSTRUCTIONS AND MANUALS

A. Instructions: Without additional charge to the Owner, furnish competent instruction to the Owner in the care, adjustment and operation of all parts of the electrical equipment and systems.

B. Manuals: Upon completion of the work, prepare and deliver to the Owner two (2) sets of complete operating and maintenance manuals for the systems and major equipment installed, suitably bound in book form and must be originals. Include catalog data, shop drawings, wiring diagrams, performance curves and rating data, spare parts lists and manufacturer's operating and maintenance data.

C. Other: The above requirements are in addition to specific instructions and manuals specified for individual systems or equipment.

1.6 SITE VISIT

A. The Contractor shall visit the site prior to bidding and satisfy themself as to the conditions under which the systems are to be installed. No subsequent allowance shall be made on their behalf for failure to make such a visit.

1.7 FIELD MEASUREMENTS

A. The Contractor shall verify the dimensions covering the work. No extra compensation shall be claimed or allowed due to difference between actual dimensions and those indicated on the drawings. No waiver of responsibility for defective work shall be claimed or allowed due to failure to report unfavorable work conditions affecting the work.

1.8 PERFORMANCE TESTS

A. Thoroughly test all fixtures, batteries, services and all circuits for proper operating condition, required durations and freedom from grounds and short circuits before acceptance is requested. All equipment, appliances and devices shall be operated under load conditions.

B. After the interior wiring system installation is complete and at such time as the Architect/Engineer may direct, conduct operating tests for approval. When requested, test all the wire, cable, devices and equipment after installation, to assure that all material continues to possess all the original characteristics as required by governing codes and standards listed in these specifications.

C. Perform such other tests as required by other sections of these specifications or as requested to prove acceptability.

D. Furnish all instruments and labor for testing.

1.9 REMODELING WORK

A. Where remodeling work is indicated, the Contractor shall be responsible for all electrical work associated with changes in, or removals of existing walls, ceilings

or floors. This work shall include rerouting of conduits, relocation of fixtures, devices and conduits as well as provision for circuit continuity for circuits in remodeled areas. The cost of all of this work shall be included in the Contractor's price with no additional compensation allowed for failure to include this work.

1.10 MISCELLANEOUS ITEMS

A. Miscellaneous items not covered in these specifications shall be as indicated on the drawings, installed and connected in the proper manner and as recommended by the manufacturer.

1.11 GUARANTEE

A. All equipment and workmanship to be furnished under this contract shall be guaranteed for a period of one year from the date of final acceptance thereof against defective materials, design and workmanship. Upon receipt of notice from the Owner of failure of any part of the guaranteed equipment during the guarantee period, the affected part or parts shall be replaced promptly with new parts by and at the expense of the Contractor. The labor incident to the installation of these replacements shall be furnished by the Contractor.

1.12 STANDARDS OF MATERIAL AND WORKMANSHIP

A. All material shall be new and shall bear the label of the Underwriter's Laboratories, Inc., or be listed under re-examination service. All material shall be of the best grade and latest pattern of manufacture as specified. All work shall be performed in a neat, workmanlike manner and shall present a neat mechanical appearance when completed.

PART 2 - PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

A. The electrical requirements for equipment specified or indicated on the drawings are based on information available at the time of design. If equipment furnished for installation has electrical requirements other than indicated on the electrical drawings, the Contractor shall make all adjustments to wire and conduit size, controls, overcurrent protection and installation as required to accommodate the equipment supplied, without additional charge to the Owner. The complete responsibility and costs for such adjustments shall be assigned to the respective section of this specification under which the equipment is furnished.

2.2 MATERIALS

A. When the product of a specific manufacturer is indicated on the drawings or specified herein by catalog number or trade name, it has been done for convenience in fixing the standard for workmanship, finish, design and the guaranteed performance. Any material, apparatus or appliance which the Contractor desires to substitute for those mentioned herein shall also conform to these standards or exceed them and shall follow the procedure as outlined under substitutions and specified herein.

B. All similar materials and equipment shall be the product of the same manufacturer.

C. Where no specific material, apparatus or appliance is mentioned, any first-class product made by a reputable manufacturer may be used, providing it conforms to the contract requirements and meets the approval of the Architect/Engineer.

D. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current and standard design.

E. Altitude: Equipment affected by altitude shall perform satisfactorily for the function intended at the altitude of the project site.

2.3 NAMEPLATES

A. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates, constructed from laminated phenolic plastic, at least 1/16" thick, three-ply, black surface and white core. Plates shall be attached by the use of stainless plate screws unless indicated otherwise. Nomenclature on the label shall include the name of the item and feeder circuit number. Equipment to be labeled shall include, but not be limited to, the following:

1. Air Conditioning Control

2. Contactors

3. Panels and Switches

4. Time Switches

5. Relays

6. Disconnect Switches

7. Starters

8. Transformers

9. Miscellaneous

10. Similar and/or related items

2.4 CHANGES

A. No changes shall be made in the electrical work as shown and herein specified, unless such changes are authorized in writing by the Architect/Engineer and such authorization shall contain a statement covering the amount of the charges involved in the change.

2.5 SUBSTITUTIONS

A. On all material, substitutions will be considered only if requested by letter from the Contractor to the Architect/Engineer. Letters must be in the engineer's office no later than 10 days prior to the bid date and shall be considered as authorized only upon written confirmation from the Architect/Engineer. Where materials are proposed to be substituted in lieu of the items specified, substitutions shall be equal in quality, workmanship and design. The burden of proof of equality of materials shall be placed upon the Contractor. Samples of all materials proposed for substitution shall be submitted to the Architect/Engineer, when requested, for examination.

2.6 SHOP DRAWINGS

A. Shop drawings shall be furnished for all equipment and materials. They shall be furnished by the Contractor as required in the Submittal Section. Where equipment will be furnished "as specified," a statement to that effect is sufficient. Where substitutions are proposed, complete data must be furnished showing performance, quality and dimensions.

B. The Contractor shall submit to the Architect/Engineer for checking a complete descriptive and technical data list for all items of material furnished under this contract. Complete outlines, dimensions, electrical services, control diagrams, electrical characteristics of special nature or critical to the installation and pertinent data required for installation shall be shown. Fixture submittals shall include scale drawings showing metal gauges and finish together with complete photometric distribution curves and coefficient of utilization tables. Glare factor curves shall also be submitted for each fixture. Failure to submit this information can be the basis for disapproval.

C. All descriptive and technical data and shop drawings shall bear signed certification that they have been carefully examined and found to be correct with respect to dimension, space available, non-interference with other trades and that the equipment complies with all the requirements of these specifications. Submittals that have not been checked for compliance will not be considered by the Engineer.

D. Only complete submittals will be considered, partial submittals will not be reviewed.

2.7 SUBMITTALS

A. Submittals shall be complete; bound booklets with an index of all items submitted including associated catalog/part numbers. The Contractor shall make submittals on all the following equipment (in addition to any special items indicated elsewhere in the plans or specifications):

1. Lighting Fixtures

2. Wiring devices

3. Conduit

4. Wire

5. Panelboards

6. Fuses

7. Starters

8. Contactors

9. Disconnect switches

10. Lamps

11. Special Systems equipment (Fire Alarm, Intrusion Alarm, Sound, TV, Lightning Protection, etc.).

B. Electrical System Controls: Refer to Section 016900 - Equipment Connections and Controls, for additional submittal requirements.

C. After receiving approval on the make and the type of materials, the Contractor shall order such materials in sufficient time to prevent any delay or changes on the job.

PART 3 - EXECUTION

3.1 GENERAL

A. Fabrication, erection and installation of the complete electrical system shall be done in a first class workmanlike manner by qualified personnel experienced in such work and shall proceed in an orderly manner so as not to hold up the progress of the project. The Contractor shall check all areas and surfaces where electrical equipment material is to be installed, removed or relocated and report any unsatisfactory conditions before starting work. Commencement of work signifies the Contractor's acceptance of existing conditions. In the acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of workmen.

3.2 EQUIPMENT

A. Equipment and materials furnished by the Contractor shall fit the spaces allocated for them. Should the equipment which the Contractor proposes to install, require space conditions other than indicated on the drawings, it shall be the Contractor's responsibility to reconcile the available space with the equipment and make any changes required to accommodate the equipment. All required changes shall be made at the Contractor's expense.

B. All equipment, both the Contractor and Owner furnished, shall be installed in accordance with the manufacturer's recommendations.

3.3 COORDINATION

A. The Electrical Plans are diagrammatic, but shall be followed as closely as actual construction and the work of other trades will allow. Such minor changes as are necessary to make the electrical work conform to the work of other trades and to the building shall be made without cost to the Owner.

3.4 CONDUITS

A. In all spaces such as ceiling spaces and equipment rooms, all conduits shall be run to a continuous grade and square to the building.

B. The plans do not give exact details as to the elevations of conduits, exact locations, etc., and do not show all off-sets, bends, junction boxes and other installation details. The Contractor shall carefully lay out their work at the site to conform to details of installation.

3.5 LOCATION OF EQUIPMENT AND OUTLETS

A. The approximate locations of cabinets, panelboards, wiring gutters, switches, light outlets, power outlets, etc., are indicated on the drawings; however, they are not intended to give complete and exact information. Determine the exact location after thoroughly examining the general building plans and by actual measurements during construction, subject to the approval of the Architect/Engineer.

B. Verify with Architect/Engineer, prior to installation, all locations of conduit, boxes, etc. stubbed or in the floor.

3.6 PROTECTION OF MATERIALS AND EQUIPMENT

A. The Contractor shall be responsible for the protection of all materials and equipment under this section of the work whether incorporated into the building or not.

B. The Contractor shall provide protection for all work where necessary and will be responsible for all damage done to property during the construction. The above protection shall be maintained while the work is in progress. In no case shall dirt, grit, etc. be ground into the floor finish or coverings.

C. The Contractor shall provide space for storage of materials and equipment at ground level.

3.7 CUTTING AND REPAIRING

A. Cutting and repairing shall be the responsibility of the Contractor. Coordinate to prevent unnecessary cutting and repairing. Lay out and locate equipment, openings and chases. Install sleeves, inserts and supports.

3.8 WARRANTY

A. Deliver originals of all guarantees and warranties on this portion of the work to Owner. Warrant all equipment, materials and workmanship for one year in accordance with the terms of this Contract.

3.9 PRODUCT HANDLING

A. Use all means necessary to protect electrical materials and equipment before, during and after installation and to protect the installed work of other trades. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no extra cost to them.

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Preparing subgrades.
   2. Excavating and backfilling.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations.
   1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. 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 dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. 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.

G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt any utilities unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.

1.5 SUBMITTALS

A. Test Reports-Excavating: Submit two (2) copies of the following reports directly to the Architect from testing service agency, one (1) copy to the Owner, and the amount of copies as required by the Contractor for his use:
   1. Test Reports on borrow material.
   2. Verification for each footing subgrade.
   3. Field density test reports.
   4. One optimum moisture-maximum density curve for each type of soil encountered.

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: Soils with plasticity index of 4 minimum to 12 maximum when tested in accordance with ASTM D-4318 and with gradation of the backfill material (determined in accordance with ASTM D- 422), having a maximum particle size of 1 inch and a maximum of 50% passing the #200 sieve.

C. Note: Soil shall be free of rock or gravel larger than 1 inch in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

D. Unsatisfactory Soils: ASTM D 2487 Soil Classification Groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols, or any soil not meeting the requirements of Part B above.

E. Backfill and Fill: Satisfactory soil materials.

F. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; New Mexico State Base Type II with a gradation as follows:

G. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; New Mexico State Base Type II with a gradation as follows:

H. Bedding: 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 sieve and not more than 8 percent passing a No. 200 sieve.

I. Detectable Warning Tape: Polyethylene film warning tape encasing a metallic core, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, freezing temperatures or frost, and other hazards created by earthwork operations. Provide protective insulating materials as necessary.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

D. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

3.2 EXCAVATION

A. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Excavate to a depth of 2' (two feet) below the bottom of all footings and slabs.

B. Excavate for structures, pavements, and walks to indicated elevations and dimensions. Extend excavations for placing and removing concrete formwork, for installing services and other construction, and for inspections. Trim bottoms to required lines and grades to leave solid base to receive other work.
   1. Excavate trenches deeper than bottom of pipe elevation, 6 inches deeper in rock, 4 inches deeper elsewhere, to allow for bedding course. Hand excavate for bell of pipe.

C. Proof roll subgrades, before filling or placing aggregate courses, with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities.

E. 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 may be used when approved by Architect. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

F. Stockpile borrow materials and satisfactory soil materials, without intermixing, in shaped, graded, drained, and covered stockpiles. Stockpile soil materials away from edge of excavations and outside drip line of remaining trees.

3.3 BACKFILLS AND FILLS

A. Utility Trench Backfill: Place, compact, and shape bedding course to provide continuous support for pipes and conduits over rock and other unyielding bearing surfaces and to fill unauthorized excavations.
   1. Place and compact initial backfill of satisfactory soil material or subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit. Place and compact final backfill of satisfactory soil material to final subgrade.
   2. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches

below subgrade under pavements and slabs.

B. Fill: Place and compact fill material in layers to required elevations.

C. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content. 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.

D. Fill and Backfill shall be uniformly moistened or aerated to within 4 percent of optimum moisture content in areas when landscaping is to be installed. This does not include under parking areas, or on building pads.

E. Compaction: Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

F. Compact soil to not less than the following percentages according to ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 6 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

G. Grading: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated. Grade lawns, walks, and unpaved subgrades to tolerances of plus or minus 1 inch and pavements and areas within building lines to plus or minus 1/2 inch.

H. Subbase and Base Courses: Under pavements and walks, place subbase course on prepared subgrade. Place base course material over subbase. Compact to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.4 FIELD QUALITY CONTROL

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

B. Allow testing agency to test and inspect subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.

C. 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 to depth required; recompact and retest until specified compaction is obtained.

3.5 PROTECTION AND DISPOSAL

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction

B. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

C. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

D. END OF SECTION 31 00 00

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Removing trees and other vegetation.
2. Removing above-grade site improvements.

B. Related Sections include the following:
1. Division 1 Section "Construction Facilities and Temporary Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
2. Division 31 00 00 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain on Owner's property, cleared materials shall become Contractor's property and shall be removed from the site unless as indicated in the Supplementary Conditions.

1.4 SUBMITTALS

A. Record drawings according to Division 1 Section "Contract Closeout."

1.5 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 authorities having jurisdiction.

B. Salvagable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Notify utility locator service for area where Project is located before site clearing.

PRODUCTS (Not Applicable)

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

2.2 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

2.3 DISPOSAL

A. Disposal: Remove unsuitable soil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 10 00

SECTION 31 23 00

EXCAVATION, BACKFILL, AND COMPACTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This Section includes furnishing labor, equipment, and incidentals necessary for excavation, backfill, and compaction for structures.

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCES

A. ASTM C131 - Resistance to Degradation of Small Size Coarse Aggregates.

B. ASTM C136 - Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

D. ASTM D1557 - Standard Test Method for Moisture Density Relations of Soil and Soil-Aggregate Mixtures Using 10-16 rammer and 18-inch drop.

E. ASTM D4253 - Standard Test Method for Maximum Index Density of Soils Using a Vibratory Table.

1.4 EXISTING CONDITIONS

A. A geotechnical investigation was performed for this site by Pettigrew & Associates. The Geotechnical report is dated July 21, 2013. These specifications are prepared using the information contained in this report.

1.5 JOB CONDITIONS

A. Use all means necessary, such as moistening of surfaces to prevent the spread of dust and creating a nuisance for adjacent areas.

1.6 SUBMITTALS

A. The results of the field density tests shall be submitted to the Architect for approval.

1.7 QUALITY ASSURANCE

A. Unless otherwise noted, all compaction will be to a density of not less than 95 percent of ASTM D1557 maximum modified density. The moisture content of the soil at the time of compaction shall be within two percent of the optimum moisture content.

PART 2 - PRODUCTS

2.1 BACKFILL

A. Most of the over-excavated soils will be suitable for use as structural fill. All structural fill shall meet the requirements for structural fill as outlined in section 2.2 of these specifications.

2.2 STRUCTURAL FILL

A. Structural fill shall be imported soil and shall meet the following requirements as determined in accordance with ASTM D-422:

Sieve Size (Square Openings)	Percent Passing by Weight
2 inch	100
1/2 inch	30-80
No. 4	20 - 60
No. 200	5 -20

The Structural fill shall have a plasticity index not greater than 15 when tested in accordance with ASTM D-4318 and should have no rocks larger than 3 inches. The fill material shall be free from roots, grass, other vegetable matter, clay lumps, or other deleterious materials.

2.3 BORROW

A. When the quantity of suitable material required for embankments is not available within the limits of the jobsite, the contractor shall provide sufficient materials to construct the embankments to the lines, elevations and cross sections as shown on the drawings from borrow areas. The contractor shall obtain from owners of said borrow areas the right to excavate material, shall pay all royalties and other charges involved, and shall pay all expenses in developing the source including the cost of right-of-way required for hauling the material.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to beginning work, carefully inspect the entire site. The drawings do not purport to show all objects existing on the site. Verify with the Architect all objects to be removed and all objects to be preserved.

B. Locate all active utility lines transversing the site, designate them and determine the requirements for their protection.

C. Approval: All scarification and compaction of existing subgrade shall be approved by the Architect before placing any fill. The placing of fill before such a notice is given and before review by the Architect is a valid reason for rejecting the fill. Placing concrete or reinforcing before compacted fill is approved by the Architect is a valid reason for rejecting the concrete so placed or for causing all reinforcing in place to be removed.

D. Building Area Treatment (including slab on grade): All soils present in the proposed new building area shall be overexcavated entirely from throughout the building area to provide for a minimum thickness of three feet of properly compacted structural fill beneath all footings and to remove all loose fill material below slabs on ground. The slabs will be supported on a minimum thickness of one foot of properly compacted structural fill. The native soil underlying the removals shall be stabilized (as required) see the overexcavation detail on Sheet S-601.

E. Compaction: All fill shall be spread in layers not exceeding 8 inches, watered as necessary and compacted. Moisture content at the time of compaction shall be within two percent of the optimum moisture content. Compaction of the fill shall be accomplished by mechanical means only to obtain a density of not less than 95 percent of maximum dry density for the building pad, paved areas, sidewalks, slabs and other structural areas. Optimum moisture content and maximum dry density for each soil type used shall be determined in accordance with ASTM D-1557. Where vibratory compaction equipment is used, it shall be the contractor's responsibility to insure that the vibrations do not damage nearby buildings or other adjacent property.

F. Weather Limitations: Controlled fill shall not be constructed when the atmospheric temperature is below 35 degrees F. When the temperature falls below 35 degrees, it shall be the responsibility of the contractor to protect all areas of completed surface against any detrimental effects of ground freezing by methods approved by the Architect. Any areas that are damaged by freezing shall be reconditioned, reshaped and compacted by the contractor in conformance with the requirements of this specification without additional cost to the owner.

G. Testing and field density tests shall be performed by an independent testing laboratory. The cost for testing and re-testing shall be borne by the contractor.

3.2 BUILDING EXCAVATION

A. Support of Excavations:

1. The contractor is required to submit a detailed plan showing the design of shoring, bracing, sloping, or provisions for worker protection from the hazard of caving ground during the excavation of any trench or trenches five feet or more in depth. The plan shall be submitted by the contractor for review by the Architect in advance of any excavation.
2. Lateral and sub-adjacent supports shall be required wherever structures or improvements adjacent to the excavation may be damaged by such excavation.
3. The sides of all excavations shall be supported in manner set forth in the rules, orders, and regulations prescribed by OSHA.
4. Shoring for the support of excavation shall remain in place until the structure is capable of safely resisting full earth loads. When shoring is no longer required in place to protect the structure or construction operations, the shoring may be removed or may be left permanently in place. If it is

feasible to remove the shoring and the contractor elects to do, the shoring sheeting and bracing shall be carefully removed so that there shall be no caving, lateral movement or flowing of the subsoils. While being withdrawn, all voids left by the sheeting and bracing shall be carefully filled with sand, and compacted as directed by the Architect.

5. If the shoring is to be left in place, it shall not act as a barrier to the natural movement of groundwater. If the shoring system is not inherently permeable enough, additional openings shall be made ahead of the backfilling operations, open size, number and location subject to review by the Architect. The contractor's excavation plan submitted before excavation is started shall indicate whether shoring is to be removed or left in place and the proposed cut off elevations below finish grade.
6. Any damage to any existing improvements of any kind resulting from a lack of adequate shoring, bracing, and sheeting shall be the responsibility of the contractor. Necessary repairs or reconstruction shall be at contractor's expense.

B. Excavated materials that are unsuitable for backfilling shall be disposed of at an approved site.

C. Protect all excavation from frost and excessive drying-out. Cut back side slopes as require to prevent slumping, or shore and brace excavations as necessary to prevent cave-ins.

D. The contractor shall keep all excavations free from water during excavation and concrete foundation work.

E. Any over-excavation of footing less than 6 inches shall be backfilled with a lean concrete. Over-excavation greater than 6 inches shall be backfilled with fill meeting the requirements set herein and compacted to 95 percent of maximum density as measured by Modified Proctor (ASTM D1557).

F. Backfilling: Do not begin backfilling until construction below finish grade has been completed, inspected, forms removed, and excavation cleaned of trash and debris. Do not place backfill in wet or frozen areas. Do not place backfill on or against foundations prior to 7 days after completion of the walls. As far as practicable, bring backfill evenly on each side of the foundation and slope to drain away from building.

3.3 FOUNDATIONS

A. Footings and on grade concrete slabs shall be placed on properly compacted structural fill as required above. The fill shall extend laterally from edge of footing a distance of five feet.

B. Non-expansive and select fill shall be placed in eight inch lifts and compacted to not less than 95 percent of Modified Proctor Density (ASTM D-1557).

C. Prior to placement of fill, exposed subgrade shall be scarified to a minimum depth of eight inches, moistened or aerated to be at or above optimum, and compacted to not less than 95 percent of Modified Proctor Density (ASTM D-1557).

3.4 FINISH GRADING

A. Grading shall be generally smooth to slopes indicated by the drawings and well compacted.

3.5 FIELD QUALITY CONTROL

A. The Contractor shall be responsible for the cost of initial testing for compliance with the specifications. Costs for retests shall be borne by the Contractor.

B. Sample Testing: Test results from representative samples of proposed Engineered (structural) fill material shall be submitted to the Architect two weeks prior to intended use. This testing shall be for specification compliance.

C. A sample of material shall be taken for each 250 cubic yards placed or each day's placement, whichever is greater, and tested for moisture-density relationship, gradation, and PI. Material not in compliance shall be removed and replaced, in accordance with the specifications, by the Contractor at no cost to the Owner. One moisture-density curve shall be prepared for each type of material used, as determined by the gradation and plasticity index.

D. Compaction tests shall be performed at a rate of one test for each 250 S.Y./lift placed, but not less than two tests per day's work per lift. Testing shall be performed in accordance with the requirements of ASTM D-1556. Areas represented by non-compliance with the test requirements shall be reworked and retested by the Contractor at no cost to the Architect or Owner. Final test reports shall be supplied to the Owner no more than two working days after the tests are completed. Non-complying tests shall be brought to the attention of the Architect and Owner at the time they are performed.

END OF SECTION 31 23 00

SECTION 31 23 23

FILL AND BACKFILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Filling, backfilling, and compacting for sidewalks, paving, curbs, drainage structures, and miscellaneous site improvements outside of the building footprint.

B. Backfilling and compacting for utilities outside the building to utility main connections.

1.2 SECTION EXCLUDES

A. Filling, backfilling, and compacting within the building footprint.

1.3 RELATED REQUIREMENTS

A. Section 31 22 00 - Grading: Removal and handling of soil to be re-used.

B. Section 31 22 00 - Grading: Site grading.

C. Section 31 23 16 - Excavation: Removal and handling of soil to be re-used.

1.4 DEFINITIONS

A. Finish Grade Elevations: Indicated on drawings.

B. Subgrade Elevations: Indicated on drawings.

1.5 REFERENCE STANDARDS

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001 (2004).

B. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.

C. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2007.

D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

E. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2007.

F. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

G. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2006.

H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

I. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

J. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2005.

1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.

C. Materials Sources: Submit name of imported materials source.

D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

E. Compaction Density Test Reports.

1.7 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. General Fill: Imported borrow.
   1. Graded.
   2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

B. Concrete for Fill: Lean concrete.

C. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
   1. Graded in accordance with ASTM C 136, within the following limits:
      a. 2 inch sieve: 100 percent passing.
      b. 1 inch sieve: 95 percent passing.
      c. 3/4 inch sieve: 95 to 100 percent passing.
      d. 5/8 inch sieve: 75 to 100 percent passing.
      e. 3/8 inch sieve: 55 to 85 percent passing.
      f. No. 4 sieve: 35 to 60 percent passing.
      g. No. 16 sieve: 15 to 35 percent passing.
      h. No. 40: 10 to 25 percent passing.
      i. No. 200: 5 to 10 percent passing.

D. Granular Fill - Pea Gravel - Fill Type I: Natural stone; washed, free of clay, shale, organic matter.
   1. Grade in accordance with ASTM D 2487 Group Symbol GM.

E. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
   1. Grade in accordance with ASTM D 2487 Group Symbol SW.

F. Topsoil: See Section 31 22 00.

2.2 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

D. Verify structural ability of unsupported walls to support imposed loads by the fill.

3.2 PREPARATION

A. Scarify and proof roll subgrade surface to a depth of 6 inches to identify soft spots.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.3 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

H. Slope grade away from building at a slope not less than 5% for a minimum of 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

I. Compaction Density Unless Otherwise Specified or Indicated:
   1. At other locations: 90 percent of maximum dry density.

J. Reshape and re-compact fills subjected to vehicular traffic.

3.4 FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:
   1. Drainage fill and geotextile fabric: Section 33 46 23.
   2. Cover drainage fill with general fill.
   3. Fill up to subgrade elevation.
   4. Compact to 95 percent of maximum dry density.

C. Over Buried Utility Piping, Conduits, and Duct Bank in Trenches:
   1. Bedding: Use general fill.
   2. Cover with general fill.
   3. Fill up to subgrade elevation.
   4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.

D. Inside Planter Boxes:
   1. Use granular fill, 4 inches deep.
   2. Cover with geotextile fabric.
   3. Cover with sand, 2 inches deep.
   4. Finish with topsoil, to within 2 inches of planter rim, lightly tamped.

E. Around and Over Underground Tanks:
   1. Use initial fill of sand.
      a. 12 inches deep.
      b. Compact to 95 percent of maximum dry density.
   2. Complete with general fill.
      a. Depth: Up to subgrade elevation.
      b. Compact to 95 percent of maximum dry density.

F. At Lawn Areas:
   1. Use general fill.
   2. Fill up to 6 inches below finish grade elevations.
   3. Fill up to subgrade elevations.
   4. Compact to 95 percent of maximum dry density.
   5. See Section 02310 for topsoil placement.

G. At Planting Areas Other Than Lawns:
   1. Use general fill.
   2. Fill up to 12 inches below finish grade elevations.
   3. Fill up to subgrade elevations.
   4. Compact to 95 percent of maximum dry density.
   5. See Section 02310 for topsoil placement.

H. At French Drains:
   1. Use granular fill.
   2. Fill up to 8 inches below finish grade.
   3. Compact to 95 percent of maximum dry density.

I. Under Pavers Set on Sand Leveling Bed:
   1. Use granular fill.
   2. Fill up to bottom of sand leveling bed.
   3. Compact to 95 percent of maximum dry density.
   4. See unit pavers section for leveling bed placement.

3.5 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.

3.6 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests:

Parking lots – 1 density per 6” lift per 6,000 sq. ft.

F. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

3.7 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION 31 23 23

SECTION 31 23 33

TRENCHING FOR SITE UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backfilling and compacting for utilities outside the building to utility main connections.

1.2 RELATED REQUIREMENTS

1.3 DEFINITIONS

1.4 REFERENCES

A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2001 (2004).

B. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)); 2007.

C. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.

D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2007.

E. ASTM D 2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.

F. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.

G. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Materials Sources: Submit name of imported materials source.

C. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Compaction Density Test Reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.

C. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. General Fill: See Section 31 23 23 and Section 31 00 00 in NMDOT Standard Specifications for Highway and Bridge Construction 2007 Edition.

B. Structural Fill: See Section 31 23 23 and Section 31 00 00 in NMDOT Standard Specifications for Highway and Bridge Construction 2007 Edition.

C. Concrete for Fill: Lean concrete.

D. Granular Fill – See Section 31 23 23 and Section 31 00 00 State of New Mexico Highway Department standard.

2.2 ACCESSORIES

2.3 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for testing and analysis of soil material.

B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.2 PREPARATION

A. See Section 31 22 00 for additional requirements.

3.3 TRENCHING

A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.

C. Do not interfere with 45 degree bearing splay of foundations.

D. Cut trenches wide enough to allow inspection of installed utilities.

E. Hand trim excavations. Remove loose matter.

F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume. See Section 02318 for removal of larger material.

H. Remove excavated material that is unsuitable for re-use from site.

I. Remove excess excavated material from site.

3.4 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.5 BACKFILLING

A. Backfill to contours and elevations indicated using unfrozen materials.

B. Employ a placement method that does not disturb or damage other work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.

F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.

G. Slope grade away from building minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

H. Correct areas that are over-excavated.
   1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

I. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.

J. Reshape and re-compact fills subjected to vehicular traffic.

3.6 BEDDING AND FILL AT SPECIFIC LOCATIONS

A. Use general fill unless otherwise specified or indicated.

B. Utility Piping, Conduits, Duct Bank.

C. At Pipe Culverts:

D. Over Subdrainage Piping at Foundation Perimeter and Under Slabs:

E. At French Drains:

3.7 TOLERANCES

3.8 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.

C. Evaluate results in relation to compaction curve determined by testing uncompacted material in

accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.

D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

E. Frequency of Tests:

Water, electrical, communication gas (outside parking or driving areas)

- 1 density per 24” depth per 300 linear feet

Water, electrical, communication gas (inside parking or driving areas)

- 1 density per 12” depth per 100 linear feet

Sewer

- 1 density per 6” depth per 100 linear feet

END OF SECTION 31 23 33

SECTION 32 12 16

HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hot-mix asphalt paving.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Material certificates.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

B. Regulatory Requirements: Comply with New Mexico State Highway and Transportation Department Standard Specifications for Highway and Bridge Construction, 2000 Edition, for asphalt paving work.

1. Mineral aggregate shall comply with Grading B, Table 420-A.

2. Aggregate base course shall conform with the requirements of Type II of Section 304, Table 304-A of the New Mexico State Highway and Transportation Department Standard Specifications for Highway and Bridge Construction.

C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

C. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO MP 1, PG 64-22.

B. Tack Coat: ASTM D 977 emulsified asphalt or ASTM D 2397cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type I.

1. Color: White.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes approved by the New Mexico State Highway and Transportation Department.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

B. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.2 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Spread mix at minimum temperature of 250°or as r equired by mix design.
2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.3 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F or as required by mix design.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Density: A minimum of 93 percent of reference maximum theoretical density according to ASTM D 2041, but not greater than 97 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

F. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.4 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.5 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

1. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film

3.6 FIELD QUALITY CONTROL

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

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

D. Type and frequency of tests shall be as described in the New Mexico Standard Specification for Public Works Construction.

3.7 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 32 12 16

SECTION 32 13 00

CEMENT CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Curbs and gutters.
3. Walkways.

B. Related Sections include the following:

1. Division 31 Section "Earthwork" for subgrade preparation, grading, and subbase course.
2. Division 32 Section "Pavement Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
3. Division 32 Section "Cast In Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

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

D. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

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

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type I or II.

1. Fly Ash: ASTM C 618, Class F or C.

C. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:
1. Class: 4M.
2. Maximum Aggregate Size: 1 inch nominal..
3. Do not use fine or coarse aggregates containing substances that cause spalling.

D. Water: ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Air-Entraining Admixture: ASTM C 260.

2.5 CURING MATERIALS

A. Water: Potable.

B. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

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.

B. Pavement-Marking Paint: Alkyd-resin type; ready mixed; complying with FS TT-P-115, Type I, or AASHTO M 248, Type N.

C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

C. Proportion mixes to provide concrete with the following properties:

1. Compressive Strength (28 Days): 3000 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6 percent, +/- 1%.

1. Air Content: 6.0 percent for 1-inch maximum aggregate.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet , unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

a. Radius: 1/4 inch

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

G. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.

1. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.

H. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

I. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

J. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.

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

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall

within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Joint Spacing: 3 inches.
8. Contraction Joint Depth: Plus 1/4 inch, no minus.
9. Joint Width: Plus 1/8 inch, no minus.

3.9 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage and pay a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.
5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded

and stored for laboratory-cured test specimens unless field-cured test specimens are required.

6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
9. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as the sole basis for approval or rejection.

E. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 00

SECTION 32 13 73

PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within portland cement concrete pavement.
2. Joints between portland cement concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 32 Section "Cement Concrete Pavement" for constructing joints in concrete paving.
2. Division 7 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 SUBMITTALS

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

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

C. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

D. Product Test Reports: From a qualified testing agency indicating joint sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that allowed by joint sealant manufacturer for application indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

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

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

2.2 COLD-APPLIED JOINT SEALANTS

A. Available Products: Subject to compliance with requirements, provide one of the following or equal:

   1. Type NS Silicone Sealant for Concrete:

      a. Roadsaver Silicone-SL; Crafco Inc.
      b. 888; Dow Corning.

2. Type SL Silicone Sealant for Concrete and Asphalt:

   a. 890-SL; Dow Corning.

3. Multi-component Low-Modulus Sealant for Concrete and Asphalt:

   a. SOF-SEAL; W.R. Meadows, Inc.

2.3 HOT-APPLIED JOINT SEALANTS

A. Available Products: Subject to compliance with requirements, provide one of the following or equal:

1. Elastomeric Sealant for Concrete:

   a. Superseal 444/777; Crafco, Inc.
   b. Poly-Jet 3406; W.R. Meadows, Inc.

2. Sealant for Concrete and Asphalt:

   a. Roadsaver 221; Crafco Inc.
   b. Product #9005; Koch Materials Company.
   c. Product #9030; Koch Materials Company.
   d. Sealtight Hi-Spec; W.R. Meadows, Inc.

2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rod for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint- sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint sealant manufacturer, based on pre-construction 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.

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

C. Install backer materials 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 backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

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

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

1. Remove excess sealants from surfaces adjacent to joint.

2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

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

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 13 73

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.

B. Roadway lane markings and crosswalk markings.

C. "No Parking" curb painting.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. FS TT-B-1325 - Beads (Glass Spheres); Retro-Reflective; Rev. D, 2007.

B. FS TT-P-1952 - Paint, Traffic Black, and Airfield Marking, Waterborne; Rev. E, 2007.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.

D. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; http://mutcd.fhwa.dot.gov; current edition.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Certificates: Submit for each batch of paint and glass beads stating compliance with specified requirements.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint: 2 containers, 1 gallon size, of each type and color.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.

B. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment accompanied by batch certificate.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MATERIALS

A. Line and Zone Marking Paint: MPI No. 97 Latex Traffic Marking Paint; color(s) as indicated.
   1. Roadway Markings: As required by authorities having jurisdiction.
   2. Parking Lots: Yellow.
   3. Handicapped Symbols: Blue.

B. Line and Zone Marking Paint: Refer to Section 09 90 00.

C. Paint For Obliterating Existing Markings: FS TT-P-1952; black for bituminous pavements, gray for Portland cement pavements.

D. Reflective Glass Beads: FS TT-B-1325, Type I (low index of refraction), Gradation A (coarse, drop-on); with silicone or other suitable waterproofing coating to ensure free flow.

E. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Obliteration of existing markings using paint is acceptable in lieu of removal; apply the black paint in as many coats as necessary to completely obliterate the existing markings.

D. Clean surfaces thoroughly prior to installation.
   1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
   2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
   3. Sandblasting: Use equipment of size and capacity necessary, providing not less than 150 cfm of air at pressure not less than 90 psi at each nozzle used.

E. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.

F. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

G. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
   1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
   2. At Contractor's option, temporary marking tape may used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.3 INSTALLATION

A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.

B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.

D. Comply with FHWA MUTCD manual (http://mutcd.fhwa.dot.gov) for details not shown.

E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.

F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the drawings true, sharp edges and ends.
   1. Apply paint in one coat only.
   2. Wet Film Thickness: 0.015 inch, minimum.
   3. Width Tolerance: Plus or minus 1/8 inch.

G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
   1. Conduct operations in such a manner that necessary traffic can move without hindrance.
   2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
   3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
   4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
   5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
   6. Distribute glass beads uniformly on the paint lines within ten seconds without any waste, applied at rate of 6 pounds per gallon of paint; if the marking equipment does not have a glass bead dispenser, use a separate piece of equipment adjusted and synchronized with the paint applicator; remove and replace markings having faulty distribution of beads.

H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other

markings indicated on drawings.

1. Mark the International Handicapped Symbol at indicated parking spaces.
2. Hand application by pneumatic spray is acceptable.

I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.4 DRYING, PROTECTION, AND REPLACEMENT

A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.

B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.

C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.

D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.

E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.

F. Replace removed markings at no additional cost to Owner.

END OF SECTION 32 17 23