SECTION 00010

TABLE OF CONTENTS

00000 COVER SHEET
00001 TITLE PAGE
00010 TABLE OF CONTENTS
00030 SIGNATURE PAGE

BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT

To be provided:

DIVISION 1 - GENERAL REQUIREMENTS

01010 SUMMARY OF WORK
01045 CUTTING AND PATCHING
01250 CONTRACT MODIFICATION PROCEDURES
01290 PAYMENT PROCEDURES
01300 ADMINISTRATIVE REQUIREMENTS
01322 PHOTOGRAPHIC DOCUMENTATION
01330 SUBMITTAL PROCEDURES
01400 QUALITY REQUIREMENTS
01420 REFERENCES
01453 CODE-REQUIRED SPECIAL INSPECTIONS
01500 CONSTRUCTION FACILITIES AND CONTROLS
01524 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01600 PRODUCT REQUIREMENTS
01630 PRODUCT SUBSTITUTIONS
01700 EXECUTION REQUIREMENTS
01770 CLOSEOUT PROCEDURES AND SUBMITTALS
01780 WARRANTIES AND BONDS
01782 OPERATION AND MAINTENANCE DATA
01810 GENERAL COMMISSIONING REQUIREMENTS
01820 DEMONSTRATION AND TRAINING

DIVISION 2 - SITEWORK

02070 SITE DEMOLITION
02110 SITE CLEARING
02221 SELECTIVE BUILDING DEMOLITION
02200 EARTHWORK
02202 ROCK-CALICHE REMOVAL
02222 EXCAVATING
02223 BACKFILLING
02225 TRENCHING
02510 ASPHALTIC CONCRETE PAVING
02520 PORTLAND CEMENT PAVING
02665 WATER SYSTEMS
02675 DISINFECTION OF WATER DISTRIBUTION SYSTEM
02730 SANITARY SEWERAGE
02765 PAVEMENT MARKINGS
02810 IRRIGATION SYSTEMS
02821 CHAIN LINK FENCE & GATES
02841 PARKING BUMPERS
02890 TRAFFIC CONTROL SIGNS
02900 LANDSCAPE WORK
**DIVISION 3 - CONCRETE**
- 03300  CAST-IN-PLACE CONCRETE
- 03351  CONCRETE FLOOR FINISHES

**DIVISION 4 - MASONRY**
- 04200  UNIT MASONRY

**DIVISION 5 - METALS**
- 05120  STRUCTURAL STEEL FRAMING
- 05310  STEEL DECKING
- 05400  COLD-FORMED METAL FRAMING
- 05500  METAL FABRICATIONS

**DIVISION 6 - WOOD AND PLASTICS**
- 06410  CUSTOM CASEWORK
- 06640  FIBER REINFORCED PLASTIC (FRP) PANELING

**DIVISION 7 - THERMAL AND MOISTURE PROTECTION**
- 07213  BUILDING INSULATION
- 07540  PVC THERMOPLASTIC MEMBRANE ROOFING
- 07620  SHEET METAL FLASHING AND TRIM
- 07710  ROOF ACCESSORIES
- 07723  ROOF HATCHES
- 07840  FIRESTOPPING
- 07900  JOINT SEALANTS

**DIVISION 8 - DOORS AND WINDOWS**
- 08111  HOLLOW METAL DOORS AND FRAMES
- 08305  ACCESS DOORS AND PANELS
- 08710  DOOR HARDWARE
- 08800  GLAZING

**DIVISION 9 - FINISHES**
- 09056  COMMON WORK RESULTS FOR FLOORING PREPARATION
- 09111  NON-STRUCTURAL METAL FRAMING
- 09240  PORTLAND CEMENT (STUCCO) PLASTER
- 09260  GYPSUM BOARD ASSEMBLIES
- 09510  SUSPENDED ACOUSTICAL CEILINGS
- 09670  RESINOUS FLOORING SYSTEMS
- 09900  PAINTING AND COATING
- 09960  ANTI-GRAFFITI COATINGS

**DIVISION 10 - SPECIALTIES**
- 10140  SIGNAGE
- 10260  WALL AND CORNER PROTECTION
- 10523  FIRE PROTECTION SPECIALTIES
- 10800  TOILET ROOM ACCESSORIES

**DIVISION 11 - EQUIPMENT**
- 11235  VIVARIUM CASEWORK & FURNISHINGS

**DIVISION 12 - FURNISHINGS**
NOT USED
DIVISION 13 - SPECIAL CONSTRUCTION
13700 TECHNICAL GENERAL REQUIREMENTS
13720 SECURITY ACCESS SYSTEMS
13722 SECURITY VIDEO SURVEILLANCE
13726 CABLE TRAYS
13851 FIRE ALARM AND SMOKE DETECTION SYSTEMS
13910 BASIC FIRE SUPPRESSION MATERIALS AND METHODS

DIVISION 14 - CONVEYING SYSTEMS
NOT USED

DIVISION 15 - MECHANICAL
15050 BASIC MECHANICAL MATERIALS AND METHODS
15060 PIPE AND PIPE FITTINGS
15100 VALVES
15120 PIPING SPECIALTIES
15121 PIPING EXPANSION COMPENSATION
15130 GAUGES AND THERMOMETERS
15140 PIPE SUPPORTS AND ANCHORS
15170 MOTOR AND VARIABLE FREQUENCY DRIVE
15190 MECHANICAL IDENTIFICATION
15240 VIBRATION ISOLATION AND SEISMIC CONTROL
15250 MECHANICAL INSULATION
15300 SPRINKLER SYSTEM
15410 PLUMBING PIPING
15430 PLUMBING SPECIALTIES
15440 PLUMBING FIXTURES
15450 PLUMBING EQUIPMENT
15480 LAB SPECIALTY SYSTEMS
15510 HYDRONIC PIPING
15535 REFRIGERANT PIPING AND SPECIALTIES
15545 CHEMICAL (WATER) TREATMENT
15750 HUMIDIFICATION SYSTEM
15855 ROOFTOP AIR HANDLING UNITS WITH COILS
15885 AIR CLEANING
15890 DUCTWORK
15910 DUCTWORK ACCESSORIES
15930 LAB PRESSURIZATION CONTROLS
15945 BUILDING COMMISSIONING
15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
15951 BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
15952 BAS OPERATOR INTERFACES
15953 BAS FIELD PANELS
15954 BAS COMMUNICATION DEVICES
15955 BASE SOFTWARE AND PROGRAMMING
15959 BAS COMMISSIONING
15980 SEQUENCES OF OPERATION
15985 multiple system integration platform
15990 TESTING, ADJUSTING, AND BALANCING

DIVISION 16 - ELECTRICAL
16010 ELECTRICAL GENERAL REQUIREMENTS
16050 BASIC ELECTRICAL MATERIALS AND METHODS
16110 RACEWAYS, BOXES AND FITTINGS
16111 CONDUIT
16112 SURFACE RACEWAYS
16120 WIRES AND CABLES
16140 WIRING DEVICES
16160 CABINETS AND ENCLOSURES
16170 GROUNDING AND BONDING
16190 SUPPORTING DEVICES
16195 ELECTRICAL IDENTIFICATION
16208 PACKAGED ENGINE GENERATOR SYSTEMS
16425 SWITCHBOARDS
16470 PANELBOARDS
16477 FUSES
16485 ENCLOSED CONTACTORS
16496 AUTOMATIC TRANSFER SWITCH
16510 INTERIOR LIGHTING
16560 EXTERIOR LIGHTING
16700 TECHNOLOGY GENERAL REQUIREMENTS
16936 MODULAR DIMMING CONTROL -LUTRON

END OF TABLE OF CONTENTS
UNLV VIVARIUM

SIGNATURES/CERTIFICATIONS

ARCHITECT
TATE SNYDER KIMSEY ARCHITECTS
JAMES WINDOM KIMSEY

Division 01
Division 06 thru 11
CIVIL ENGINEER
LOCHSA ENGINEERING
GUY M. MORRIS

DIVISION 02
STRUCTURAL ENGINEER
LOCHSA ENGINEERING
JOHN R. ZIELINSKI

Section 03300
Section 04200
Section 05120
Section 05310
ELECTRICAL ENGINEER
PROFESSIONAL DESIGN ASSOCIATES, INC.
GEORGE T. FOSTER, JR.

DIVISION 16
SECTION 01010  
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Contract Description.
B. Work by Owner
C. Contractor Use of Site and Premises.
D. Owner Occupancy.

1.2 CONTRACT DESCRIPTION:

A. The "Project" of which the "Work" of this contract is titled UNLV Vivarium, 4505 Maryland Parkway, University of Nevada Las Vegas, Nevada 89154. The Work is to be under single general contract.

B. The Work consists of the construction of a new 5,229 sf building on the UNLV campus, adjacent to Juanita Greer White Life Sciences Building. The building will be one story in height and the structure will be reinforced concrete masonry walls and structural columns on spread footings. A combination of open web joists and W-beams will support the steel roof deck and roof top mechanical equipment. The interior will be fit out with walls, ceilings, flooring, doors, casework, and all associate mechanical, plumbing, and electrical systems. Site work will include grading, new utility connections and underground work, as well as minor flatwork and landscaping.

C. Demolition includes the removal existing CMU structures including roof, walls, ceilings, flooring, doors, and associated flatwork. Demolition also includes the removal of the existing mechanical, plumbing, and electrical systems within the area to be demolished. Contractor shall coordinate with the owner regarding the salvaging of any Owner property.

1.3 COMMUNICATION

A. Communications with the Architect shall be copied to the Owner's Project Representative.
B. Communications with the Architect's consultants shall go through the Architect.
C. Communications with the Owner's Project Representative shall be appropriately copied to the Architect.

1.4 WORK BY OWNER:

A. Items noted as NIC (Not in Contract) on the drawings and schedules will be supplied and installed by the Owner. NIC items may be installed by the Owner prior to completion of the Work.

B. Items noted as O.F.C.I (Owner Furnished Contract or Installed) will be provided by the Owner for installation by the Contractor.

1.5 CONTRACTOR USE OF SITE AND PREMISES:

A. Limit use of site to allow Owner occupancy and use of existing adjacent facilities. Construction operations shall be limited to areas approved by the Owner.
B. 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.
   3. Provide traffic control during the construction to minimize any inconvenience to the guests of the property.
   4. The Contractor's use of the site will be defined by the Contract Limits indicated for the Contractor's operations during the construction time period.
   5. During construction, where operations may cause vibration or noise, cooperate with the Owner as to the times that those operations may take place.
   6. Maintain fire lanes required by local Fire Department and other access routes required by the Owner.

C. Existing building spaces may not be used for storage.

D. Time Restrictions:
   1. Limit conduct of especially noisy, malodorous, and dusty exterior work as directed by the Owner.

E. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

F. Protection of existing conditions:
   1. The Contractor shall be responsible to protect existing buildings and both on and off-site work from any damage due to their Work on this Project. Damage caused by the Contractor shall be satisfactorily repaired at no cost to the Owner.

G. Provide seven (7) day advanced notice to Owner prior to any Work than may require removal or protection of Owner equipment and material.

H. Utility Outages and Shutdown: Provide seven (7) day notice of scheduled shutdowns and immediate notification of unscheduled utility interruptions to site.

1.6 OWNER OCCUPANCY:

A. The Owner will occupy the existing buildings on campus during the course of the construction and will conduct business during the construction.

B. Coordinate progress schedule with Owner to minimize conflict and to facilitate Owner's operation.

C. The Owner reserves the right to control the hours of operation of selected activities, primarily dust-producing and noise producing work, which would adversely affect the occupants and use of the existing facility. The Contractor shall coordinate all such work with the Owner.

1.7 WORK SEQUENCE:

A. Construct Work in phases during the construction period:
   1. Phase 1: Build the entire shell and MEP infrastructure. The south half of the building is finished.
   2. Phase 2: Complete build out of north half of building.
1.8 CONSTRUCTION DOCUMENTS:

A. The Contractor shall maintain at the Project Site, a stamped, complete set of full size Construction Documents including a bound set of the Specifications.

B. The Contractor shall maintain at the Project Site, material and finish control samples.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. This section specifies the cutting and patching of nominally completed and/or previously existing work in order to accommodate the coordination of Work, to install other Work, to uncover other Work for access or inspection, to obtain samples for testing, or for similar purposes; and excludes integral cutting and patching during the manufacturing, fabricating, erecting, and installing of individual units of Work, including attendant excavation and backfill necessary to complete the Work.

B. Refer to other sections of the Specifications for specific cutting and patching requirements and limitations applicable to individual units of work.

1.2 RELATED SECTIONS:

A. Section 01700 - Execution Requirements: For final cleaning requirements.

B. Section 07840 - Firestopping: For patching fire rated construction.

C. Section 01732 - Selective Demolition.

1.3 DEFINITIONS:

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittal requirements.

B. Minimum 2 week notification in advance of executing any cutting or alterations, submit written request(s) to the Owner for consent to proceed with cutting which affects:
   1. Work of Owner or other trades.
   2. Structural value or integrity of any element of the Project.
   3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
   4. Efficiency, operational life, maintenance or safety of operational elements.
   5. Visual qualities of sight-exposed elements.
   6. Owner operations.

C. Product Data:
   1. Submit manufacturer’s product data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
D. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Necessity: Describe why cutting and patching cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Description of proposed Work:
   a. Scope of cutting, patching, alteration, or excavation.
   b. Trades which will execute Work.
   c. Products proposed to be used.
   d. Extent of refinishing to be done.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Cost proposal, when applicable.
8. Written permission of trades who’s Work will be affected.
9. Architects Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE:

A. Structural Elements: Do not cut and patch structural elements without written approval from Structural Engineer.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include (but are not limited to) the following:
   1. Primary LRT operational, systems, and equipment (trackwork, ductbank, signals, ticket vending/validator, CCTV, variable message boards, Overhead Catenary System etc.).
   2. Utility systems piping, drains (storm and sanitary) and plumbing.
   3. Communication systems (fiber optic).
   4. Electrical wiring systems (lighting, etc.) and vaults.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
   1. Water, moisture, or vapor barriers.
   2. Joint material.
   3. Membranes and flashings.
   4. Exterior curtain-wall construction.
   5. Equipment supports.
   6. Piping, ductwork, vessels, and equipment.
   7. Noise-and vibration-control elements and systems.
   8. Handrails and fences.
D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
   a. Processed concrete finishes.
   b. Stonework and stone masonry.
   c. Roofing.
   d. Firestopping.
   e. Window wall system.
   f. Fluid-applied flooring.
   h. Wall covering.
   i. HVAC enclosures, cabinets, or covers.

1.6 PAYMENT FOR COSTS:

A. Cost caused by ill-timed or defective Work or Work not conforming to Contract Documents, including costs for additional services of Architect and Engineer to be paid by Contractor.

B. Cost of Work done on written instructions of Architect, other than defective or nonconforming Work, will be paid by Owner on approval by the Owner, on approval of written Change Order. Provide written cost proposals prior to proceeding with cutting and patching proposed by Architect.

1.7 WARRANTY:

A. See Section 017836 – Warranties and Bonds; for additional warranty requirements.

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

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Provide for replacement of Work removed.

C. Where required patch materials are not specified, use materials which will result in equal or better work than work being cut and patched in terms of performance characteristics and visual effects.

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

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.
E. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
   1. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with solvent-free, two-component, epoxy protective coating.
   2. Product and Manufacturer: Provide one of the following:
      b. Or approved equal.

F. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 25 00 - Substitution Procedures.

PART 3 - EXECUTION

3.1 EXAMINATION:

   A. Inspect existing conditions of Work, including elements subject to movement or damage during cutting and patching, and excavating and backfilling. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

   B. Submit request in advance of cutting or alteration which 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.

   C. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

   D. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

   E. Report unsatisfactory or questionable conditions in writing to Owner and Architect and Engineer. Do not proceed with work until further instructions are received.

3.2 PREPARATION:

   A. Contractors shall be responsible for exact location and size of all holes, sleeves, and openings required to be cut, formed, built-in or necessary for their work.

   B. Temporary Support: Provide shoring, bracing and supports as necessary to maintain structural integrity of work.

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

   D. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

   E. Provide protection from elements for areas which may be exposed by uncovering work.

   F. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
3.3 PERFORMANCE:

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
   2. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes as shown on Drawings and as specified.
   3. Fit Work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces. Conform to fire code requirements for penetrations and maintain integrity of fire walls and ceilings.
   4. Restore Work which has been cut or removed. Install new products to provide completed Work in accordance with requirements of Contract Documents and as required to match surrounding areas and surfaces.
   5. Execute excavating and backfilling by methods which prevent damage to other work and settlement as specified in Section 31 01 00.

B. Coring: Core-drill holes to be cut through concrete and masonry walls, slabs, or arches, unless otherwise accepted by Engineer in writing.
   1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
   2. Do not core-drill through electrical conduit or other utility lines embedded in walls or slabs without approval of Engineer. To extent possible, avoid cutting reinforcing steel in slabs and walls.
   3. Protection:
      a. Protect existing equipment, utilities, and adjacent areas from water and other damage covered by core-drilling operations.
      b. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.E of this Section. Apply protective coating in accordance with manufacturer’s instructions.

C. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete, Stucco and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   5. Proceed with patching after construction operations requiring cutting are complete.
   6. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   7. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
8. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

9. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

10. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

11. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Concrete Masonry Units: Provide new materials of same texture, color, and size. Tooth new masonry into existing. Match joint size, profile and color to existing.

E. Floor Finishes:
1. Cut back and reinstall including carpeting and pad to accommodate installation of doors and trim. Provide new tack strips, trim and padding as required for a complete and finished installation.
2. Patch wood flooring with compatible species of wood. Finish with stain to match existing, and three coats of polyurethane floor varnish.
3. Patch concrete terrazzo floors where required with compatible material to provide a finished installation.

F. Electrical: Extend existing electrical devices where application of new drywall or installation of new duct enclosures is required. Devices include lights, fans, receptacles, switches, telephone jacks, cable TV jacks, thermostats, smoke detectors, audio jacks and other electrical systems. Provide new plaster rings, boxes and wiring as needed and in conformance with electrical codes.

G. Drywall: Patch drywall with new materials to provide a level surface with texture to match adjacent surface. Use metal trim at corners. Where drywall butts dissimilar materials, use metal "LC" trim that is taped into drywall leaving a finished appearance with no metal showing. Use perforated joint tape and ready mixed joint compound on joints.

H. Plaster: Provide an even surface of uniform finish, color, texture, and appearance. Match texture of adjacent surface. Remove existing wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

I. Stucco: Mix and apply stucco in two coats to match existing texture. Provide new wire lath and corner beads if required by conditions. If existing stucco is an integral color material provide new stucco in matching integral color.

J. Painting: Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire wall surface containing the patch to the edges of natural breaks. Provide additional coats until patch blends with adjacent surfaces.

K. Existing Hardware Removal: Where existing window and door frames remain in openings that have new products installed, complete the following:
1. Remove existing hardware and hardware parts which are no longer in use.
2. Patch holes remaining after removal. Fill holes more than 1/4 inch deep with wood infill, glued in place. Holes less than 1/4 inch deep may be filled with wood or with spackle.
3. Patch to blend with existing surface. Sand smooth and paint to match.
3.4 CLEANING:

A. Refer also to Section 01700 - Execution Requirements for final cleaning requirements.

B. Cleaning and Restoration:
   1. Clean areas and spaces where cutting, coring, or patching were performed.
   2. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
   3. Restore damaged coverings of pipe and other utilities to original condition

END OF SECTION
SECTION 01250
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Administrative and procedural requirements for handling and processing Contract modifications.

1.2 RELATED REQUIREMENTS:

A. Section 01630 – Product Substitutions for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 DEFINITIONS

A. Modification: A Modification is defined as one of the following:
   1. An Architect's Supplemental Instruction; (ASI)
   2. A Change Order; (CO)
   3. A Construction Change Directive; (CCD)
   4. Or a written amendment to the Contract signed by Owner, Architect, and Contractor.

1.4 MINOR CHANGES IN THE WORK:

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions (ASI)."

1.5 PROPOSAL REQUESTS:

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
   2. Within time specified in Proposal Request or 20 days, when not otherwise specified after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
      e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
   1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01630 – Product Substitutions, if the proposed change requires substitution of one product or system for product or system specified.

1.6 CHANGE ORDER PROCEDURES:

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701. Change Orders may only be approved if the Architect agrees and signs the Change Order form.

1.7 CONSTRUCTION CHANGE DIRECTIVE:

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

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION
SECTION 01290
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Administrative and procedural requirements for preparation and submittal of:
   1. Schedule of Values.
   2. Applications for Payment.
   3. Progress Payments.
   4. Final Payment.

B. Administrative and procedural requirements necessary to prepare and process

1.2 RELATED REQUIREMENTS:

A. Section 01250 - Contract Modification Procedures for administrative procedures for handling changes to the Contract.

B. Section 01700 – Execution Requirements.

1.3 DEFINITIONS:

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES:

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
      c. Items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
   3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
   4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
   5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 01010 - Summary of Work.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. **Identification:** Include the following Project identification on the schedule of values:
   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.

3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
      1) Labor.
      2) Materials.
      3) Equipment.

   a. Include separate line items under principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

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

6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.

9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

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

1.5 **APPLICATIONS FOR PAYMENT:**

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

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Application for Payment to Architect by the last of the month. The period covered by each Application for Payment is one month, ending on the **last day of the month**.
   1. Submit draft copy of Application for Payment [seven] days prior to due date for review by Architect.

D. Application for Payment Forms: Use **AIA Document G702** and **AIA Document G703** as form for Applications for Payment.

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

F. Application for Payment Forms: Use forms acceptable to **Architect** and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. **Architect** will return incomplete applications without action.
   1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
   2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
   3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
   4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
   1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
   3. Provide summary documentation for stored materials indicating the following:
      a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
      b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
      c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

I. Transmittal: Submit three signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt **within 24 hours**. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit conditional final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

K. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of values.
   3. Contractor's construction schedule (preliminary if not final).
   4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
   5. Products list (preliminary if not final).
   6. Schedule of unit prices.
   7. Submittal schedule (preliminary if not final).
   8. List of Contractor's staff assignments.
  12. Initial progress report.
  14. Certificates of insurance and insurance policies.
  15. Performance and payment bonds.
  16. Data needed to acquire Owner's insurance.

L. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

M. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited to, the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   6. AIA Document G707, "Consent of Surety to Final Payment."
   7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Requests for Information (RFIs).
   4. Project Web site.
   5. Project meetings.

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

1.2 RELATED REQUIREMENTS:

A. Section 01700 - Execution Requirements for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

B. Section 01732 – Selective Demolition: for Pre-demolition meetings.

C. Section 01770 - Closeout Procedures for coordinating closeout of the Contract.

D. Section 01810 - General Commissioning Requirements for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS:

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

1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

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

C. Key Personnel Names: Within fifteen (15) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES:

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Preinstallation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS:

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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.
   1. 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:
      a. 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.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. 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.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. 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.

6. Mechanical and Plumbing Work: Show the following:
a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:
a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that 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 changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01330 - Submittal Procedures.

1.7 REQUESTS FOR INFORMATION (RFIs):

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
   2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
   1. Project name.
   2. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect.
   6. RFI number, numbered sequentially.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
      a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716, Software-generated form with substantially the same content as indicated above, acceptable to Architect.
   1. Attachments shall be electronic files in Adobe Acrobat PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven (7) working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01250 - Contract Modification Procedures.
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within ten (10) days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI number including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven (7) days if Contractor disagrees with response.
   1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
   2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS:

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
   1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
   2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
   3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three (3) days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than Fifteen (15) days after execution of the Agreement.
   1. Conduct the conference to review responsibilities and personnel assignments.
   2. 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.
   3. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Tentative construction schedule.
      b. Phasing.
      c. Critical work sequencing and long-lead items.
      d. Designation of key personnel and their duties.
      e. Lines of communications.
      f. Procedures for processing field decisions and Change Orders.
      g. Procedures for RFIs.
      h. Procedures for testing and inspecting.
      i. Procedures for processing Applications for Payment.
j. Distribution of the Contract Documents.
k. Submittal procedures.
l. Preparation of record documents.
m. Use of the premises and existing building.
n. Work restrictions.
o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

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

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility requirements.
   k. Time schedules.
   l. Weather limitations.
   m. Manufacturer's written instructions.
   n. Warranty requirements.
   o. Compatibility of materials.
   p. Acceptability of substrates.
   q. Temporary facilities and controls.
   r. Space and access limitations.
   s. Regulations of authorities having jurisdiction.
   t. Testing and inspecting requirements.
   u. Installation procedures.
   v. Coordination with other work.
   w. Required performance results.
   x. Protection of adjacent work.
   y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than [90] days prior to the scheduled date of Substantial Completion.
   1. Conduct the conference to review requirements and responsibilities related to Project closeout.
   2. Attendees: Authorized representatives of Owner, 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.
   3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
      a. Preparation of record documents.
      b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
      c. Submittal of written warranties.
      d. Requirements for preparing operations and maintenance data.
      e. Requirements for delivery of material samples, attic stock, and spare parts.
      f. Requirements for demonstration and training.
      g. Preparation of Contractor's punch list.
      h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
      i. Submittal procedures.
      j. Coordination of separate contracts.
      k. Owner's partial occupancy requirements.
      l. Installation of Owner's furniture, fixtures, and equipment.
      m. Responsibility for removing temporary facilities and controls.
   4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.
   1. Coordinate dates of meetings with preparation of payment requests.
   2. 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.
   3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
         1) Review schedule for next period.
      b. Review present and future needs of each entity present, including the following:
         1) Interface requirements.
         2) Sequence of operations.
         3) Resolution of BIM component conflicts.
         4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Progress cleaning.
11) Quality and work standards.
12) Status of correction of deficient items.
13) Field observations.
14) Status of RFIs.
15) Status of proposal requests.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

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

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

1. Attendees: In addition to representatives of Owner, 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.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
   c. Review present and future needs of each contractor present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Resolution of BIM component conflicts.
      4) Status of submittals.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site utilization.
      9) Temporary facilities and controls.
      10) Work hours.
      11) Hazards and risks.
      12) Progress cleaning.
13) Quality and work standards.
14) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and
to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION
SECTION 01322
PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final completion construction photographs.

1.2 RELATED REQUIREMENTS:

A. Section 01770 - Closeout Procedures and Submittals, for submitting photographic documenta-
   tion as project record documents at Project closeout.

B. Section 01820 - Demonstration and Training for submitting video recordings of demonstration of
equipment and training of Owner's personnel.

C. Section 02221 - Selective Building Demolition for photographic documentation before selective
demolition operations commence.

1.3 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Qualification Data: For photographer and Web-based photographic documentation service
   provider.

C. Key Plan: Submit key plan of Project site and building with notation of vantage points marked
   for location and direction of each photograph. Indicate elevation or story of construction.
   Include same information as corresponding photographic documentation.

D. Digital Photographs: Submit image files within three days of taking photographs.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect
      ratio as the sensor, uncropped, date and time stamped, in folder named by date of
      photograph, accompanied by key plan file.
   3. Identification: Provide the following information with each image description in file
      metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Name of Architect.
      d. Name of Contractor.
      e. Date photograph was taken.
      f. Description of vantage point, indicating location, direction (by compass point),
         and elevation or story of construction.
      g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE:

A. Photographer Qualifications: An individual who has been regularly engaged as a professional
   photographer of construction projects for not less than three years.
1.5 USAGE RIGHTS:

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA:


PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS:

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.

2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect and Construction Manager.

D. Preconstruction Photographs: Before commencement of demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect or Construction Manager.

1. Flag construction limits before taking construction photographs.

2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.

3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

E. Periodic Construction Photographs: Take 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Architect or Construction Manager-Directed Construction Photographs: From time to time, the Architect or Construction Manager will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

G. Time-Lapse Sequence Construction Photographs: Take (20) photographs as indicated, to show status of construction and progress since last photographs were taken.

1. Frequency: Take photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment.
2. Vantage Points: Following suggestions by Architect or Construction Manager and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two (2) of the required shots from same vantage point each time to create a time-lapse sequence as follows:
   a. Commencement of the Work, through completion of subgrade construction.
   b. Above-grade structural framing.
   c. Exterior building enclosure.
   d. Interior Work, through date of Substantial Completion.

H. Final Completion Construction Photographs: Take min. (20) color photographs after date of Substantial Completion for submission as project record documents. Architect or Construction Manager will inform photographer of desired vantage points.
   1. Do not include date stamp.

I. Additional Photographs: Architect or Construction Manager may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
   1. Three days' notice will be given, where feasible.
   2. In emergency situations, take additional photographs within 24 hours of request.
   3. Circumstances that could require additional photographs include, but are not limited to, the following:
      a. Special events planned at Project site.
      b. Immediate follow-up when on-site events result in construction damage or losses.
      c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
      d. Substantial Completion of a major phase or component of the Work.
      e. Extra record photographs at time of final acceptance.
      f. Owner's request for special publicity photographs.

END OF SECTION
SECTION 01330
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Delegated-Design Services.

B. Submittals.
   1. Submittal Schedule.
   2. Submittals for Review.
   3. Submittals for Information.
   4. Submittals for Project Closeout.
   5. Number of copies of submittals.

C. Engineered Deferred Submittals.

1.2 RELATED SECTIONS:

A. General Conditions of the Contract.

B. Section 01400 - Quality Requirements.

C. Section 01770 – Closeout Procedures and Submittals.

1.3 DELEGATED-DESIGN SERVICES:

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of General Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to General Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. Refer to Paragraph 3.7 - Engineered Deferred Submittals.

PART 2 - PRODUCTS - NOT USED.
PART 3 - EXECUTION

3.1 SUBMITTALS SCHEDULE:

A. After the General Contractor's Construction Schedule has been developed and accepted, prepare a complete schedule of submittals.
   1. Two weeks after notice to proceed, General Contractor shall prepare the Submittals Requirements Schedule in detail:
      a. Use one line per item for each section and paragraph number
      b. Provide one copy for the Owner and one copy for the Architect of Record.
      c. Obtain Architect of Record's and Project Manager's approvals
   2. Coordinate the Submittal Schedule with the General Contractor's Construction Schedule, Schedule of Values, Subcontracts, list of products and other pertinent information.
   3. Coordinate submittals into logical groupings to facilitate interrelation of several items:
      a. Finishes which involve Architect of Record selection of colors, textures or patterns.
      b. Associated items which require correlation for efficient function or for installation.
      c. Provide:
         1) All submittals required by a particular section at one time.
         2) Shop drawings, schedules, product data, coordination drawings, samples, color charts and other information as required (whether listed or not) for Architect of Record's complete evaluation.
         3) Define the deferred submittal schedule.
      d. Incomplete information or partial submittals will be cause for rejection.
   4. Prepare the schedule in chronological order and provide the following:
      a. Scheduled date for the initial submittal.
      b. Section number per this specification.
      c. Submittal category (Shop Drawing, Product Data or Sample).
      d. Name of General Contractor.
      e. Description of the part of the work covered by this submittal.
      f. Date required for this submittal to be returned but not less than the stipulated date herein.

B. After approval of the Submittal Schedule, distribute in print and electronically in pdf format to the Owner's representative, Architect, subcontractors and all other parties required to comply with the dates indicated in the Submittal Schedule.
   1. Submit the Submittal Schedule within 10 days of the date required for submittal of the General Contractor's Construction Schedule.

C. Update and reissue the Submittal Schedule after revised dates, agreed upon by the affected parties, have been approved.

D. Submittal schedule shall be updated periodically to reflect changes in the construction schedule.

3.2 SUBMITTALS FOR REVIEW:

A. Submittals shall be numbered according to Architect's Project Manual of Specifications.

B. When the following are specified in individual sections, submit them for review:
   1. Product data: Collect information into a single submittal for each element of construction and type of product or equipment.
      a. Submit only pages which are pertinent. Mark each copy of standard printed data to identify relevant products and the related Specification Section and Article Number.
b. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

c. Mark each copy of each submittal to show which products and options are applicable.

d. Include the following information, as applicable:
   1) Manufacturer's catalog cuts.
   2) Manufacturer's product specifications.
   3) Performance characteristics and capacities
   4) Finishes
      a) Standard color charts.
   5) Component parts
   6) Statement of compliance with specified referenced standards.
   7) Testing by recognized testing agency.
   8) Application of testing agency labels and seals.
   9) Notation of coordination requirements.
  10) Other information as required by the individual specification sections
  11) Availability and delivery time information.

e. For equipment, include the following in addition to the above, as applicable:
   1) Wiring diagrams showing factory-installed wiring.
   2) Printed performance curves.
   3) Operational range diagrams.
   4) Dimensions
   5) Clearances required to other construction, if not indicated on accompanying Shop Drawings.

f. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information that is not applicable.

g. Submit Product Data before or concurrent with Samples.

h. Submit Product Data in the following format:
   1) PDF electronic file.

2. Shop drawings: Submit newly prepared Project-specific information, drawn accurately to scale.

   a. Do not reproduce Contract Documents or copy standard product information as the basis of Shop Drawings.
      1) Submittals received on the Architect's Titleblock will be automatically rejected.

   b. Present in a clear and thorough manner Job Specific shop drawings. (Generic shop drawings will be rejected.) Title each drawing sheet with Project Name and Number; identify each element of the drawings by reference to Sheet Number and Detail, Specification Section, Schedule or Room Number listed in the Contract Documents and CAD Standards Manual.

   c. Standard information prepared without specific reference to the Project is not a Shop Drawing.

   d. Identify field dimensions; show relation to adjacent or critical features of Work or Products.

   e. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      1) Identification of products.
      2) Schedules.
      3) Compliance with specified standards.
      4) Notation of coordination requirements.
      5) Notation of dimensions established by field measurement.
      6) Relationship and attachment to adjoining construction clearly indicated.
      7) Seal and signature of professional engineer if specified.
f. Scale Required: Unless otherwise specifically directed by Architect of Record, make all shop drawings accurate to a scale sufficiently large enough to show all pertinent features of the item and its methods of connection to the Work.

g. Submit Shop Drawings in the following format:

1) PDF electronic file.

h. Provide a 5” x 4” blank space on each submittal sheet or sample label for Architect of Record’s review stamp.

C. Samples for Selection:

1. Provide 4 of each sample or color chart.
2. Submit full range of manufacturer’s standard finishes, except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Architect of Record’s selection. ALL color charts shall be originals, no photocopies allowed.
3. Submit samples to illustrate functional characteristics of products, including parts and attachments.
4. Label each sample with Project Name and Number, Interior Design Specification Number (as applicable), and Room Number.
5. Mock-up: Provide field samples of finishes and assemblies at the site as required by individual specification sections.
   a. Install each sample or assembly complete and finished.
   b. Locate as directed by the Owner or Architect of Record.
   c. Acceptable mock-up may or may not remain as part of the Work at the Architect of Record’s discretion.

D. Samples for Verification:

1. Provide 6 of each sample or color chart.
2. Submit full range of manufacturer’s standard finishes, except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Architect of Record’s selection. ALL color charts shall be originals, no photocopies allowed.
3. Submit samples to illustrate functional characteristics of products, including parts and attachments.
4. Label each sample with Project Name and Number, Interior Design Specification Number (as applicable), and Room Number.

E. Samples will be reviewed only for aesthetic, color, or finish selection.

1. Submit sample of material in size, finish, texture and color as required by the specific specification section and indicating the range of any variations that may occur.

F. After review, provide copies and distribute in accordance with Submittal Procedures article below and for record documents purposes described in Section 01770 - Closeout Procedures.

G. Fire Alarm/Fire Sprinkler System Shop Drawings shall be submitted to the Architect whose approval shall be obtained prior to the submittal to the state and local Fire Marshall.

3.3 SUBMITTALS FOR INFORMATION:

A. When the following are specified in individual sections, submit them for information:

1. Design data.
2. Certificates.
3. Test reports.
4. Inspection reports.
5. Manufacturer’s instructions.
6. Manufacturer’s field reports.
7. Other types indicated.

B. Submit for Architect’s knowledge as the Owner’s Contract Administrator or for the Owner’s record. No action will be taken.
3.4 SUBMITTALS FOR PROJECT CLOSEOUT:

A. Submit for Owner's benefit during and after project completion and in accordance with Section 01770 - Closeout Procedures and Submittals.

B. When the following are specified in individual sections, submit them at project closeout:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties & Bonds
   4. Other types as indicated.

3.5 NUMBER OF COPIES OF SUBMITTALS:

A. Documents for Review:
   1. Small Size Sheets, Not Larger than 8-1/2 x 11 inches: Submit one electronic copy; the Contractor shall make his own copies from original returned by the Architect after making his own file copy.

B. Documents for Information: Submit one electronic copy to Architect of Record.

C. Extra Copies at Project Closeout: See Section 01781. Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.

D. Samples: Submit the number specified in individual specification sections or 4 of each if no specific number is specified in the specific section; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.6 SUBMITTAL PROCEDURES:

A. All submittals shall be in accordance with the General Conditions of the Contract.

B. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

C. Schedule submittals to expedite the Project and coordinate submission of related items. The General Contractor is solely responsible for coordinating the delivery of submittals, including any necessary corrections and resubmittals, to assure that Architect of Record approval can be obtained without delaying the Work. The General Contractor shall start the submittal process within three weeks after award or as required to meet the Contract Schedule requirements.

D. Transmit each submittal with a copy of approved submittal form.

E. General: Electronic copies of the digital files of the Construction Documents may be made available by the Architect for the General Contractor's use in the preparation of the Submittals. The Architect nor the General Contractor shall be obligated to use such documents in the preparation of the Submittals.
   1. Transfer of the digital files from the Architect to the General Contractor shall be subject to the Terms and Conditions of a Digital File Transfer Agreement at the time of such transfer.
   2. The use of the digital files prepared by the Architect in the preparation of the Shop Drawings shall not in any way obviate the recipient's responsibility for the proper checking and coordination of dimensions, field conditions, details, member sizes, gauges, quantities, and any other condition as required to facilitate complete and accurate fabrication and erection.
F. Transmit each submittal with approved form.

G. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

H. Identify Project Manager, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

I. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

J. General Contractor Review:
   1. Review submittals (prior to sending to Architect of Record) to determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
   2. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
   4. Sign or initial each sheet of shop drawings and product data or each sample label to certify compliance with the requirements of Contract Documents using a submittal stamp with the following information incorporated:
      a. General Contractor Submittal Approval
      b. By making this Submittal No. ________, (Insert General Contractor's Name) does hereby approve said submittal and does certify that it has determined and verified all materials, field measurements and field construction criteria related thereto, and has checked and coordinated the information within this submittal with the requirements of the Work and Contract Documents.
      c. Signed for the General Contractor: _______________ Date: __________.

K. Submittal Mark-ups:
   1. Submittals shall be marked-up as follows:
      a. Contractor Comments: Make all Contractor comments in "Blue" ink.
      b. Design Team will make all comments in "Red" ink.

L. Identify Project number, General Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy. Architect will not review submittals that do not bear the General Contractor's approval stamp and will return them without action.

M. Apply General Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.

N. All submittals NOT made through the General Contractor will be rejected.

O. The Architect will return unsolicited submittals without action.

P. No portion of the Work which requires a shop drawing or sample submission shall be commenced until the submission has been reviewed and returned as approved by Architect of Record.

Q. Deliver physical submittals to Architect at business address.

R. Schedule submittals to expedite the Project, and coordinate submission of related items.
S. For each submittal for the initial review, allow 10 days excluding delivery time to and from the Contractor.
   1. For concurrent review of submittals by Consultants, Owner and other parties, allow 5 additional days excluding time to and from the Contractor.
   2. Extension of review time shall not constitute a basis to automatically extend the Contract time.

T. For each resubmittal, allow for 14 days excluding time to and from the General Contractor.

U. Submittals and Samples shall be submitted in a timely manner to allow for resubmittal and not cause a delay in the Work.

V. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.

W. Provide space of approximately 5" x 4" for Contractor and Architect review stamps.
   1. General Contractor shall include the following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Project number.
      d. Name and address of Architect.
      e. Name and address of General Contractor.
      f. Name and address of Subcontractor.
      g. Name and address of Supplier.
      h. Name of Manufacturer.
      i. Unique identifier, including revision number(s).
      j. Number and title of appropriate Specification Section.
      k. Drawing number and detail references, as appropriate.
      l. Other necessary identification.
   2. Architect shall mark the action stamp indicating the action taken.

X. When revised for resubmission, identify all changes made since previous submission.
   1. The General Contractor shall make any corrections required by the Architect of Record and resubmit.
      a. The General Contractor shall direct specific attention in writing or on the resubmitted shop drawings to revisions other than the correction(s) required by Architect of Record on previous submissions.
      b. When revised for resubmission, identify all changes made since previous submission.
      c. The revised submittal will be identified with the original submittal number plus a suffix to mark it as a resubmittal, i.e. 005-09910-R1, 005-09910-a or 005-09910-A. If not so identified, the resubmittal will be returned as revise and resubmit with the proper number.

Y. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

Z. Electronic submittals must be provided in a portable Document Format (.pdf) file when submitted electronically.
   1. Prepare file for submittal by converting it to PDF using Adobe Acrobat Pro 9.0® or later version. Legible scanned PDF files of plain paper documents are acceptable, but PDF sets created by electronically converting files using Adobe Acrobat Pro® are preferable. Scanned documents are more difficult to annotate, are usually less legible, and produce larger attachment sizes.
   2. Ensure that sheets are ready to print out to a PDF format on the appropriate sheet size, with no additional formatting required by the viewer, and with all required information.
3. The option in Adobe Acrobat Pro® to print “Documents and Markups” in the “Print What” drop down list on the “Print” options window must be chosen to correctly see all applicable information in the request answer. This will ensure all pertinent information is printed if the document is printed.

4. Electronic signatures and stamps must be utilized on electronic submittals where signatures and stamps are required in Section 3.1 Submittal Schedule items A.1-4 and Section 3.6 Submittal Procedures items A-X above.

AA. Substitutions will not be considered when they are indicated or implied on shop drawings, product data submittals or samples without a separate written request complying with the requirement in Section 01630 – Product Substitutions.

BB. Maintain one (1) set of all approved submittals at the Project Site in the General Contractors office.

3.7 ENGINEERED DEFERRED SUBMITTALS:

A. Definition: Per 2012 International Building Code (IBC) (Section 107.3.4.2).
1. Portions of the design that are not submitted at the time of the (permit) application and that are to be submitted to the building official within a specified period.”

B. Documents for deferred submittal items shall be submitted to the registered design professional in responsible charge [EOR], (through the Architect of Record), who shall review them and forward them, to the General Contractor, who will forward them to the building official with a notation indicating that the deferred documents have been reviewed and found to be in general conformance to the design of the building.

C. Contractor is responsible for making all submittals of deferred items to the Building Officials, (AHJ).

D. Refer to deferred submittal items on the Construction Documents.

E. Deferred Submittals include but are not limited to the following list. Provide as applicable to the Project.
1. Ceiling Framing systems.
2. Fire Alarm System.
3. Fire Sprinkler System.
4. Safety Platform and guardrails at rooftop mechanical units.

F. Deferred submittal documents and drawings must be submitted and approved prior to the construction/installation of the deferred item.

G. All pre-engineered, pre-fabricated, pre-manufactured or other products designed after issuance of a permit must be designed for loads and deflection criteria as required by the applicable edition of the International Building Code (IBC).

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. References.

B. Quality control and control of installation.

C. Testing and Inspection Agencies.

D. Tolerances, Labeling, Mock-up requirements.

E. Design data and calculations.

F. Test reports and certifications.

G. Manufacturer’s installation instructions.

H. Testing and inspection services.

I. Manufacturer’s field services.

J. Defect Assessment

1.2 RELATED SECTIONS:

A. Section 01300 - Administrative Requirements:

B. Section 01453 - Code-Required Special Inspections: Code-required special inspections.

1.3 REFERENCES:


G. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
H. Conform to reference standard by date of issue current on date of Contract Documents except where specific date is established by code.

I. Obtain copies of standards where required by product specification sections.

J. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

K. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.4 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Testing Agency Qualifications:
   1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

D. Test Reports: After each test/inspection, promptly submit (within 24 hours) the listed number of copies:
   1. Distribution:
      a. (1) Copy to the Architect.
      b. (1) Copy to the Structural Engineer.
      c. (2) Copies to the Contractor.
      d. (1) Copy to the Owner's Representative.
   2. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Conformance with Contract Documents.
      k. When requested by the Architect, Owner's Representative, or the Contractor; provide interpretation of results.

E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit report within 5 days of observation to Architect for information.
   2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.5 QUALITY CONTROL AND 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. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer 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. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

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

1.6 TESTING AND INSPECTION AGENCIES

A. Owner will employ and pay for services of an independent certified testing agency acceptable to the Architect and Contractor to perform specified testing and inspection as required and specified in the Contract Documents.

B. Contractor shall employ and pay for services of an independent certified testing agency acceptable to the Architect and Owner to perform specified testing and inspections required to be performed and paid for by the Contractor.

C. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

D. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

E. Contractor Employed Agency:
   2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
   3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
   4. Laboratory: Authorized to operate in State.
   5. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
6. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

1.7 TESTING LABORATORY SERVICES

A. Contractor shall retain an independent testing laboratory, acceptable to the Owner, to perform their Work called for in the Specifications, and pay cost of services.

B. Contractor shall furnish samples for such tests and deliver them to the testing agency as directed by the Owner.

D. The testing laboratory shall distribute copies of reports as follows:
   1. (2) copies to the Owner
   2. (1) copy to the Civil Engineer
   3. (2) copies to the Contractor

E. Costs for retesting required due to Contractor’s failure to comply with specified requirements shall be paid for by the Contractor.

F. The following list is intended as a guide to the Contractor to aid in the determining testing requirements for the project, however, the requirements specified in the technical sections shall take precedence over this list and this list is not to be interpreted as being complete.
   1. 02300 - Earthwork: Test imported fill materials if required, observation of earthwork by Geotechnical Engineer, density and moisture testing of trench backfill, field density tests of underslab fill and backfill.
   2. 02740 - Asphaltic Concrete Paving: Smoothness tests
   3. 03300 - Cast-In-Place Concrete: Test cylinders, slump test(s)

1.8 CONTRACTOR’S QUALITY CONTROL

A. Where Specifications require that a particular product be installed and/or applied by an Applicator approved by the Manufacturer, it is the Contractor's responsibility to ensure that Subcontractor employed for such Work is approved. Such Subcontractor(s) shall provide evidence of being approved when requested by the Architect.

B. Work shall be executed by mechanics skilled in the Work required. Conform to the methods, standards and accepted practices of the Trade or Trades involved.

1.9 TOLERANCES:

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers’ tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.10 LABELING:

A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
   1. Model number.
2. Serial number.
3. Performance characteristics.

1.11 MOCKUPS:
A. Definition:
1. Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner and Architect that illustrate materials, equipment, or workmanship.
2. Approved mockups establish the standard of quality by which the Work will be judged.
B. Construct, apply, or assemble specified items, with related attachment and anchorage devices, flashings, seals, and finishes.
C. Perform work in accordance with applicable specifications sections.
D. Erect at project site at location acceptable to Architect. Protect from damage.
E. Removal:
1. Mockups may remain as part of the Work only when so designated in individual specification sections.
2. Do not remove mockups until removal is approved by Architect or upon Final Completion.
3. Where mockup is not permitted to remain as part of the Work, clear area after removal of mockup has been approved by Architect.

1.12 DESIGN DATA AND CALCULATIONS:
A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide design data and calculations.
B. Accuracy of design data and calculations is the responsibility of the Contractor.
C. When so specified, prepare design data and calculations under the direction of a professional engineer licensed in the state of Nevada. Affix engineer’s seal to submittals.

1.13 TEST REPORTS AND CERTIFICATIONS:
A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide test reports and manufacturers’ certifications.
B. Indicate that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
C. Submittals may be recent or previous test results on material or Product, but must be acceptable to Architect.

1.14 MANUFACTURER’S INSTALLATION INSTRUCTIONS:
A. When Contract Documents require that Products be installed in accordance with manufacturer’s instructions:
1. Submit manufacturer’s most recent printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, as applicable.
   a. Submit in quantities specified for Product Data.
   b. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
   c. Identify conflicts between manufacturers’ instructions and requirements of Contract Documents.
2. Perform installation of Products to comply with requirements of manufacturer's instructions.
3. If installation cannot be performed in accordance with manufacturer's instructions, notify Architect and await instructions.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 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.

3.2 EXAMINATION:

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
B. Verify 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. Verify utility services are available, of correct characteristics, and in correct locations.

3.3 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 new material or substance in contact or bond.
3.4 TESTING AND INSPECTION SERVICES:

A. Owner will employ and pay for specified services of an independent firm to perform testing and inspection.

B. See individual specification sections for testing and inspection required. The following list is only intended to be a guide for the Contractor to aid in determining the testing requirements for the Project. The requirements specified in each specific section shall take precedence over this list and this list is not to be interpreted as being a complete list.
   1. 02300 - Earthwork
   2. 02740 - Asphaltic Concrete Paving
   3. 03300 - Cast-in-Place Concrete
   4. 05120 - Structural Steel Framing.
   5. 05310 - Steel Decking.
   6. 05400 - Cold-Formed Metal Framing.
   8. 07840 - Firestopping
   9. 07900 - Joint Sealants
   10. Division 9 - Flooring Sections regarding moisture content of concrete floors.

C. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer.
   1. Laboratory: Authorized to operate in State of Nevada.
   2. Laboratory Staff: Maintain full time registered Engineer on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

D. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.

E. Reports will be submitted by independent firm to Owner, Architect/Engineer, Contractor, and authority having jurisdiction, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
   1. Submit final report indicating correction of Work previously reported as non-compliant.

F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

G. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

H. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

I. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   3. Perform specified sampling and testing of products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-
   conformance of Work or products.
6. Perform additional tests required by Architect/Engineer.

J. Agency Reports: After each test, promptly submit report to Owner, Architect/Engineer,
   Contractor, and authority having jurisdiction. When requested by Architect/Engineer, provide
   interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.

K. Limits On Testing Authority:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of
      Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

L. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be
      used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be
         tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify laboratory 24 hours minimum, in advance, prior to expected time for operations
      requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional
      samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections
      required by Contractor beyond specified requirements.

M. Re-testing required because of non-conformance to specified requirements shall be performed
by the same agency.
   1. Re-testing required because of non-conformance to specified requirements shall be
      paid for by Contractor.

3.5 MANUFACTURERS’ FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or
   manufacturers to provide qualified staff personnel to observe site conditions, conditions of
   surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and
   balance of equipment and others as applicable, and to initiate instructions when necessary.

B. Such Manufacturer's personnel shall be accompanied by the Contractor during his time at the
   site.
C. Submit qualifications of observer to Architect 30 days in advance of required observations.
   1. Observer subject to approval of Owner.

D. Report observations and site decisions or instructions given to applicators or installers that are
   supplemental or contrary to manufacturers' written instructions.

3.6 DEFECT ASSESSMENT

A. General: On completion of testing, inspecting, sample taking, and similar services, repair
   damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other
      Specification Sections. Restore patched areas and extend restoration into adjoining
      areas with durable seams that are as invisible as possible.
   2. Comply with the Contract Document requirements for Section 01 73 29 - Cutting and
      Patching.

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

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

D. Replace Work or portions of the Work not conforming to specified requirements.

E. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will
   direct an appropriate remedy or adjust payment.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. This section supplements the definitions contained in the General Conditions.

B. Other definitions are included in individual specification sections.

1.2 DEFINITIONS:

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

B. "Approved equal", "or equal" shall mean as approved and accepted by the Architect and/or Owner.

C. "As necessary" means essential to the completion of the work.

D. "As required" means as required by the contract documents.

E. "As selected", "as approved" or words of similar import mean as selected by, as approved by, or as accepted by the Architect and/or Owner.

F. "As shown", "as detailed", "as indicated" or words of similar import mean as indicated on the drawings.

G. "Clear" shall mean to hold to a dimension certain.

H. "Concealed" means not visible in the finished work.

I. "Exposed" means visible in the finished work.

J. "Connect": To make the complete necessary utility connection (water, sewer, gas, electricity, etc.) from the building utility to the piece of equipment to allow that piece of equipment to function as intended (e.g., a gas connection for an oven or cooktop).

K. "Days" means calendar days.

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

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

N. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

O. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
“Product”: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

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

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

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

"Shall" means mandatory.

“Supply”: Same as Furnish.

"Working Days" means work days and does not include legal holidays as defined by the Contract.

1.3 OWNER FURNISHED - OWNER INSTALLED ITEMS (OFOI):

A. General: The terms "Furnish," "Install," and "Connect" shall be as defined in Paragraph 1.2 of this Section.

B. Items furnished and installed by the Owner: Refer to Contract for OFOI items.

C. Contractor's Responsibilities:
   1. Contractor shall give the Owner written notification, stating the date(s) when the Owner Furnished items must be received at the job site to insure Project completion in accordance with the established schedule. Such dates shall be shown on the schedule.
   2. Contractor is responsible for the coordination and interface of the Owner-Furnished and Installed Items (OFOI) with the Work of this Contract to provide all necessary mechanical and electrical rough-ins, openings, supports, dimensions, clearances, etc., required for a complete and functional installation.

1.4 OWNER FURNISHED - CONTRACTOR INSTALLED ITEMS (OF_CI):

A. General: The terms "Furnish," "Install," and "Connect" shall be as defined in Paragraph 1.2 of this Section.

B. Items furnished by the Owner and installed by the Contractor: Refer to Contract for OFCI items.

C. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed Shop Drawings, Product Data, and Samples, to the Contractor.
   2. Arrange and pay for product delivery to site.
   3. Upon delivery, inspect products jointly with Contractor.
   4. Immediately upon observing the product, submit any claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for Manufacturers' warranties, inspections and service.

D. Contractor's Responsibilities:
   1. Contractor shall provide a written schedule to the Owner, indicating when the Owner-Furnished items must be received at the project site to insure the Project completion in
accordance with the established schedule. Such dates shall be shown on the schedule.

2. Review of the Owner-reviewed Shop Drawings, Product data, and Samples.
3. Receive and unload products at the site. Inspect for completeness or damage jointly with the Owner.
4. Handle, store, assemble, install, protect, connect and finish products including furnishing lubricants and fluids and other procedures necessary to cause products to be operative and serviceable.
5. Contractor shall be responsible for the coordination with the Owner- Furnished items and to provide for all of the necessary mechanical and electrical rough-ins, openings, supports, dimensions, clearances, etc. required for a complete and functional installation.

1.5 SPECIFICATION FORMAT AND CONTENT EXPLANATION:

A. Specifications are organized into Divisions and Sections based on 50-division format and CSI/CSC's "Master Format" numbering system.

B. Specifications use certain conventions for style of language and intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Interpret singular words as plural and plural words as singular where applicable, as context of Contract Documents indicates.
      a. Words "shall," "shall be," or "shall comply with," depending on context, are implied where colon (:) is used within sentence or phrase.

1.6 INDUSTRY STANDARDS:

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

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
   1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.7 ABBREVIATIONS AND ACRONYMS:

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

   AABC Associated Air Balance Council (202) 737-0202
   www.aabc.com

   AAMA American Architectural Manufacturers Association (847) 303-5664
   www.aamanet.org

   AASHTO American Association of State Highway and Transportation Officials (202) 624-5800
   www.transportation.org
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<th>Acronym</th>
<th>Name</th>
<th>Website</th>
<th>Phone</th>
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<tr>
<td>AATCC</td>
<td>American Association of Textile Chemists and Colorists</td>
<td><a href="http://www.aatcc.org">www.aatcc.org</a></td>
<td>(919) 549-8141</td>
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<tr>
<td>ABMA</td>
<td>American Bearing Manufacturers Association</td>
<td><a href="http://www.americanbearings.org">www.americanbearings.org</a></td>
<td>(202) 367-1155</td>
</tr>
<tr>
<td>ACI</td>
<td>American Concrete Institute</td>
<td><a href="http://www.concrete.org">www.concrete.org</a></td>
<td>(248) 848-3700</td>
</tr>
<tr>
<td>ACPA</td>
<td>American Concrete Pipe Association</td>
<td><a href="http://www.concrete-pipe.org">www.concrete-pipe.org</a></td>
<td>(972) 506-7216</td>
</tr>
<tr>
<td>AEIC</td>
<td>Association of Edison Illuminating Companies, Inc. (The)</td>
<td><a href="http://www.aeic.org">www.aeic.org</a></td>
<td>(205) 257-2530</td>
</tr>
<tr>
<td>AF&amp;PA</td>
<td>American Forest &amp; Paper Association</td>
<td><a href="http://www.afandpa.org">www.afandpa.org</a></td>
<td>(800) 878-8878 (202) 463-2700</td>
</tr>
<tr>
<td>AGA</td>
<td>American Gas Association</td>
<td><a href="http://www.agawww">www.agawww</a></td>
<td>(202) 824-7000</td>
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<tr>
<td>AHAM</td>
<td>Association of Home Appliance Manufacturers</td>
<td><a href="http://www.aham.org">www.aham.org</a></td>
<td>(202) 872-5955</td>
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<tr>
<td>AHRI</td>
<td>Air-Conditioning, Heating, and Refrigeration Institute (The)</td>
<td><a href="http://www.ahrinet.org">www.ahrinet.org</a></td>
<td>(703) 524-8800</td>
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<tr>
<td>AI</td>
<td>Asphalt Institute</td>
<td><a href="http://www.asphaltinstitute.org">www.asphaltinstitute.org</a></td>
<td>(859) 288-4960</td>
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<tr>
<td>AIA</td>
<td>American Institute of Architects (The)</td>
<td><a href="http://www.aia.org">www.aia.org</a></td>
<td>(800) 242-3837 (202) 626-7300</td>
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<tr>
<td>AISC</td>
<td>American Institute of Steel Construction</td>
<td><a href="http://www.aisc.org">www.aisc.org</a></td>
<td>(800) 644-2400 (312) 670-2400</td>
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<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
<td><a href="http://www.steel.org">www.steel.org</a></td>
<td>(202) 452-7100</td>
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<td>AITC</td>
<td>American Institute of Timber Construction</td>
<td><a href="http://www.aitc-glulam.org">www.aitc-glulam.org</a></td>
<td>(303) 792-9559</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
<td><a href="http://www.ansi.org">www.ansi.org</a></td>
<td>(202) 293-8020</td>
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<td>AOSA</td>
<td>Association of Official Seed Analysts, Inc.</td>
<td><a href="http://www.aosaseed.com">www.aosaseed.com</a></td>
<td>(607) 256-3313</td>
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<tr>
<td>APA</td>
<td>APA - The Engineered Wood Association</td>
<td><a href="http://www.apawood.org">www.apawood.org</a></td>
<td>(253) 565-6600</td>
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APA Architectural Precast Association  
www.archprecast.org  
(239) 454-6989

API American Petroleum Institute  
www.api.org  
(202) 682-8000

ARI Air-Conditioning & Refrigeration Institute  
(See AHRI)

ARI American Refrigeration Institute  
(See AHRI)

ARMA Asphalt Roofing Manufacturers Association  
www.asphaltroofing.org  
(202) 207-0917

ASCE American Society of Civil Engineers  
www.asce.org  
(800) 548-2723  
(703) 295-6300

ASCE/SEI American Society of Civil Engineers/Structural Engineering Institute  
(See ASCE)

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers  
www.ashrae.org  
(800) 527-4723  
(404) 636-8400

ASME ASME International  
(American Society of Mechanical Engineers)  
www.asme.org  
(800) 843-2763  
(973) 882-1170

ASSE American Society of Safety Engineers (The)  
www.asse.org  
(847) 699-2929

ASSE American Society of Sanitary Engineering  
www.asse-plumbing.org  
(440) 835-3040

ASTM ASTM International  
(American Society for Testing and Materials International)  
www.astm.org  
(610) 832-9500

ATIS Alliance for Telecommunications Industry Solutions  
www.atis.org  
(202) 628-6380

AWEA American Wind Energy Association  
www.awea.org  
(202) 383-2500

AWI Architectural Woodwork Institute  
www.awinet.org  
(571) 323-3636

AWMAC Architectural Woodwork Manufacturers Association of Canada  
www.awmac.com  
(403) 453-7387

AWPA American Wood Protection Association  
(Formerly: American Wood-Preservers' Association)  
www.awpa.com  
(205) 733-4077
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<td>AWS</td>
<td>American Welding Society</td>
<td>(800) 443-9353</td>
<td><a href="http://www.aws.org">www.aws.org</a></td>
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<td>AWWA</td>
<td>American Water Works Association</td>
<td>(800) 926-7337</td>
<td><a href="http://www.awwa.org">www.awwa.org</a></td>
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<td>BHMA</td>
<td>Builders Hardware Manufacturers Association</td>
<td>(212) 297-2122</td>
<td><a href="http://www.buildershardware.com">www.buildershardware.com</a></td>
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<tr>
<td>BIA</td>
<td>Brick Industry Association (The)</td>
<td>(703) 620-0010</td>
<td><a href="http://www.gobrick.com">www.gobrick.com</a></td>
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<tr>
<td>BICSI</td>
<td>BICSI, Inc.</td>
<td>(800) 242-7405</td>
<td><a href="http://www.bicsi.org">www.bicsi.org</a></td>
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<td>BIFMA</td>
<td>BIFMA International (Business and Institutional Furniture Manufacturer's Association)</td>
<td>(613) 285-3963</td>
<td><a href="http://www.bifma.com">www.bifma.com</a></td>
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<tr>
<td>BISSC</td>
<td>Baking Industry Sanitation Standards Committee</td>
<td>(866) 342-4772</td>
<td><a href="http://www.bissc.org">www.bissc.org</a></td>
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<tr>
<td>BOCA</td>
<td>BOCA (Building Officials and Code Administrators International Inc.) (See ICC)</td>
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<td>BWF</td>
<td>Badminton World Federation (Formerly: International Badminton Federation)</td>
<td>60 3 9283 7155</td>
<td><a href="http://www.bwfbadminton.org">www.bwfbadminton.org</a></td>
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<td>CDA</td>
<td>Copper Development Association</td>
<td>(800) 232-3282</td>
<td><a href="http://www.copper.org">www.copper.org</a></td>
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<td>CEA</td>
<td>Canadian Electricity Association</td>
<td>(613) 230-9263</td>
<td><a href="http://www.electricity.ca">www.electricity.ca</a></td>
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<td>CEA</td>
<td>Consumer Electronics Association</td>
<td>(866) 858-1555</td>
<td><a href="http://www.ce.org">www.ce.org</a></td>
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<td>CFFA</td>
<td>Chemical Fabrics &amp; Film Association, Inc.</td>
<td>(216) 241-7333</td>
<td><a href="http://www.chemicalfabricsandfilm.com">www.chemicalfabricsandfilm.com</a></td>
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<td>CFSEI</td>
<td>Cold-Formed Steel Engineers Institute</td>
<td>(866) 465-4732</td>
<td><a href="http://www.cfsei.org">www.cfsei.org</a></td>
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<td>CGA</td>
<td>Compressed Gas Association</td>
<td>(703) 788-2700</td>
<td><a href="http://www.cganet.com">www.cganet.com</a></td>
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<td>CIMA</td>
<td>Cellulose Insulation Manufacturers Association</td>
<td>(888) 881-2462</td>
<td><a href="http://www.cellulose.org">www.cellulose.org</a></td>
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<td>CISCA</td>
<td>Ceilings &amp; Interior Systems Construction Association</td>
<td>(630) 584-1919</td>
<td><a href="http://www.cisca.org">www.cisca.org</a></td>
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<td>CISPI</td>
<td>Cast Iron Soil Pipe Institute</td>
<td>(404) 622-0073</td>
<td><a href="http://www.cispi.org">www.cispi.org</a></td>
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<td>CLFMI</td>
<td>Chain Link Fence Manufacturers Institute</td>
<td>(301) 596-2583</td>
<td><a href="http://www.chainlinkinfo.org">www.chainlinkinfo.org</a></td>
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<td>CPA</td>
<td>Composite Panel Association</td>
<td>(703) 724-1128</td>
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<td>CRI</td>
<td>Carpet and Rug Institute (The)</td>
<td>(706) 278-3176</td>
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<td>CRRC</td>
<td>Cool Roof Rating Council</td>
<td>(866) 465-2523</td>
<td><a href="http://www.coolroofs.org">www.coolroofs.org</a></td>
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<td>CRSI</td>
<td>Concrete Reinforcing Steel Institute</td>
<td>(800) 328-6306</td>
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<td>CSA</td>
<td>Canadian Standards Association</td>
<td>(800) 463-6727</td>
<td><a href="http://www.csa.ca">www.csa.ca</a></td>
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<td>CSA</td>
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<td>(866) 797-4272</td>
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<td>CSI</td>
<td>Construction Specifications Institute (The)</td>
<td>(800) 689-2900</td>
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<td>CSSB</td>
<td>Cedar Shake &amp; Shingle Bureau</td>
<td>(604) 820-7700</td>
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<td>(281) 583-4087</td>
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<td>CWC</td>
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<td>DASMA</td>
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<td>(216) 241-7333</td>
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<td>DHI</td>
<td>Door and Hardware Institute</td>
<td>(703) 222-2010</td>
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<td>ECA</td>
<td>Electronic Components Association</td>
<td>(703) 907-8024</td>
<td><a href="http://www.ec-central.org">www.ec-central.org</a></td>
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<td>EIMA</td>
<td>EIFS Industry Members Association</td>
<td>(800) 294-3462</td>
<td><a href="http://www.eima.com">www.eima.com</a></td>
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<td>EJMA</td>
<td>Expansion Joint Manufacturers Association, Inc.</td>
<td>(914) 332-0040</td>
<td><a href="http://www.ejma.org">www.ejma.org</a></td>
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<td>(315) 339-6937</td>
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<td>EVO</td>
<td>Efficiency Valuation Organization</td>
<td>(415) 367-3643</td>
<td><a href="http://www.evo-world.org">www.evo-world.org</a></td>
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<td>FM Approvals</td>
<td>FM Approvals LLC</td>
<td>(781) 762-4300</td>
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<td>FM Global</td>
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<td>(401) 275-3000</td>
<td><a href="http://www.fmglobal.com">www.fmglobal.com</a></td>
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<td>FRSA</td>
<td>Florida Roofing, Sheet Metal &amp; Air Conditioning Contractors Association, Inc.</td>
<td>(407) 671-3772</td>
<td><a href="http://www.floridarooft.com">www.floridarooft.com</a></td>
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<td>FSA</td>
<td>Fluid Sealing Association</td>
<td>(610) 971-4850</td>
<td><a href="http://www.fluidsealing.com">www.fluidsealing.com</a></td>
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<td>FSC</td>
<td>Forest Stewardship Council U.S.</td>
<td>(612) 353-4511</td>
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<td>(301) 277-8686</td>
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<td>(785) 271-0208</td>
<td><a href="http://www.glasswebsite.com">www.glasswebsite.com</a></td>
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<td>Green Seal</td>
<td>(202) 872-6400</td>
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<td>Hydraulic Institute</td>
<td>(973) 267-9700</td>
<td><a href="http://www.pumps.org">www.pumps.org</a></td>
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<td>HPW</td>
<td>H. P. White Laboratory, Inc.</td>
<td>(410) 838-6550</td>
<td><a href="http://www.hpwhite.com">www.hpwhite.com</a></td>
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<td>IAPSC</td>
<td>International Association of Professional Security Consultants</td>
<td>(415) 536-0288</td>
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UNLV Vivarium
June 17, 2016 – Permit Set

01420 Page 8
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<td>Insulated Cable Engineers Association, Inc.</td>
<td><a href="http://www.icea.net">www.icea.net</a></td>
<td>(770) 830-0369</td>
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<td>ICPA</td>
<td>International Cast Polymer Alliance</td>
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<td>International Concrete Repair Institute, Inc.</td>
<td><a href="http://www.icri.org">www.icri.org</a></td>
<td>(847) 827-0830</td>
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<td>IEC</td>
<td>International Electrotechnical Commission</td>
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<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers, Inc. (The)</td>
<td><a href="http://www.ieee.org">www.ieee.org</a></td>
<td>(212) 419-7900</td>
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<td><a href="http://www.iest.org">www.iest.org</a></td>
<td>(847) 981-0100</td>
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<td>(405) 744-5175</td>
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<td><a href="http://www.iliai.com">www.iliai.com</a></td>
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<td>Manufacturers Standardization Society of The Valve and</td>
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<td>(202) 737-2926</td>
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NAIMA  North American Insulation Manufacturers Association  www.naima.org  (703) 684-0084

NBGQA  National Building Granite Quarries Association, Inc.  www.nbqga.com  (800) 557-2848

NCAA  National Collegiate Athletic Association (The)  www.ncaa.org  (317) 917-6222

NCMA  National Concrete Masonry Association  www.ncma.org  (703) 713-1900

NEBB  National Environmental Balancing Bureau  www.nebb.org  (301) 977-3698

NECA  National Electrical Contractors Association  www.necanet.org  (301) 657-3110

NeLMA  Northeastern Lumber Manufacturers Association  www.nelma.org  (207) 829-6901

NEMA  National Electrical Manufacturers Association  www.nema.org  (703) 841-3200

NETA  International Electrical Testing Association  www.netaworld.org  (888) 300-6382  (269) 488-6382

NFHS  National Federation of State High School Associations  www.nfhs.org  (317) 972-6900

NFPA  NFPA (National Fire Protection Association)  www.nfpa.org  (800) 344-3555  (617) 770-3000

NFRC  National Fenestration Rating Council  www.nfrc.org  (301) 589-1776

NHLA  National Hardwood Lumber Association  www.nhla.com  (800) 933-0318  (901) 377-1818

NLGA  National Lumber Grades Authority  www.nlga.org  (604) 524-2393

NOFMA  National Oak Flooring Manufacturers Association  (See NWFA)

NOMMA  National Ornamental & Miscellaneous Metals Association  www.nomma.org  (888) 516-8585

NRCA  National Roofing Contractors Association  www.nrca.net  (800) 323-9545  (847) 299-9070

NRMCA  National Ready Mixed Concrete Association  www.nrmca.org  (888) 846-7622  (301) 587-1400
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<td>NSPE</td>
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<td>PDI</td>
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<td><a href="http://www.pdionline.org">www.pdionline.org</a></td>
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<td>(800) 589-8956</td>
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<td>(978) 557-0720</td>
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<td>RCSC</td>
<td>Research Council on Structural Connections</td>
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<td><a href="http://www.boltcouncil.org">www.boltcouncil.org</a></td>
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<td>RFCI</td>
<td>Resilient Floor Covering Institute</td>
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<td><a href="http://www.rfci.com">www.rfci.com</a></td>
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<td>(706) 882-3833</td>
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<td>RIS</td>
<td>Redwood Inspection Service</td>
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<td><a href="http://www.redwoodinspection.com">www.redwoodinspection.com</a></td>
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<td>(925) 935-1499</td>
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<td>SAE</td>
<td>SAE International</td>
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<td></td>
<td>(Society of Automotive Engineers)</td>
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<td><a href="http://www.sae.org">www.sae.org</a></td>
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<tr>
<td></td>
<td>(877) 606-7323</td>
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<td>(724) 776-4841</td>
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<tr>
<td>SBCCI</td>
<td>Southern Building Code Congress International, Inc. (See ICC)</td>
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<td><a href="http://www.sbcCi.org">www.sbcCi.org</a></td>
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<td>SCTE</td>
<td>Society of Cable Telecommunications Engineers</td>
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<td><a href="http://www.scte.org">www.scte.org</a></td>
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<td></td>
<td>(800) 542-5040</td>
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<td>(610) 363-6888</td>
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<td>SDI</td>
<td>Steel Deck Institute</td>
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<td><a href="http://www.sdi.org">www.sdi.org</a></td>
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<td>(847) 458-4647</td>
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<td>SDI</td>
<td>Steel Door Institute</td>
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<td><a href="http://www.steeldoor.org">www.steeldoor.org</a></td>
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<td>(440) 899-0010</td>
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<td>SEFA</td>
<td>Scientific Equipment and Furniture Association</td>
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<td><a href="http://www.sefalabs.com">www.sefalabs.com</a></td>
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<td>(877) 294-5424</td>
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<td>(516) 294-5424</td>
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<td>SEI/ASCE</td>
<td>Structural Engineering Institute/American Society of Civil Engineers (See ASCE)</td>
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<td><a href="http://www.siaonline.org">www.siaonline.org</a></td>
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<td></td>
<td>(866) 817-8888</td>
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<td>(703) 683-2075</td>
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SJII Steel Joist Institute
www.steeljoist.org
(843) 293-1995

SMA Screen Manufacturers Association
www.smainfo.org
(773) 636-0672

SMACNA Sheet Metal and Air Conditioning Contractors' National Association
www.smacna.org
(703) 803-2980

SMPTE Society of Motion Picture and Television Engineers
www.smpte.org
(914) 761-1100

SPFA Spray Polyurethane Foam Alliance
www.sprayfoam.org
(800) 523-6154

SPIB Southern Pine Inspection Bureau
www.spib.org
(850) 434-2611

SPRI Single Ply Roofing Industry
www.spri.org
(781) 647-7026

SRCC Solar Rating and Certification Corporation
www.solar-rating.org
(321) 638-1537

SSINA Specialty Steel Industry of North America
www.ssina.com
(800) 982-0355
(202) 342-8630

SSPC SSPC: The Society for Protective Coatings
www.sspc.org
(877) 281-7772
(412) 281-2331

STI Steel Tank Institute
www.steeltank.com
(847) 438-8265

SWI Steel Window Institute
www.steelwindows.com
(216) 241-7333

SWPA Submersible Wastewater Pump Association
www.swpa.org
(847) 681-1868

TCA Tilt-Up Concrete Association
www.tilt-up.org
(319) 895-6911

TCNA Tile Council of North America, Inc.
(Formerly: Tile Council of America)
www.tileusa.com
(864) 646-8453

TEMA Tubular Exchanger Manufacturers Association, Inc.
www.tema.org
(914) 332-0040

TIA Telecommunications Industry Association
(Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance)
www.tiaonline.org
(703) 907-7700

TIA/EIA Telecommunications Industry Association/Electronic Industries Alliance
<table>
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<th>Acronym</th>
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<tr>
<td>TMS</td>
<td>The Masonry Society</td>
<td>(303) 939-9700</td>
<td><a href="http://www.masonrysociety.org">www.masonrysociety.org</a></td>
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<tr>
<td>TPI</td>
<td>Truss Plate Institute</td>
<td>(703) 683-1010</td>
<td><a href="http://www.tpinst.org">www.tpinst.org</a></td>
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<td>TRI</td>
<td>Tile Roofing Institute</td>
<td>(312) 670-4177</td>
<td><a href="http://www.tileroofing.org">www.tileroofing.org</a></td>
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<tr>
<td>UBC</td>
<td>Uniform Building Code</td>
<td>(877) 854-3577</td>
<td>(See ICC)</td>
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<tr>
<td>UNI</td>
<td>Uni-Bell PVC Pipe Association</td>
<td>(972) 243-3902</td>
<td><a href="http://www.uni-bell.org">www.uni-bell.org</a></td>
</tr>
<tr>
<td>USGBC</td>
<td>U.S. Green Building Council</td>
<td>(800) 795-1747</td>
<td><a href="http://www.usgbc.org">www.usgbc.org</a></td>
</tr>
<tr>
<td>WASTEC</td>
<td>Waste Equipment Technology Association</td>
<td>(800) 424-2869</td>
<td><a href="http://www.wastec.org">www.wastec.org</a></td>
</tr>
<tr>
<td>WCLIB</td>
<td>West Coast Lumber Inspection Bureau</td>
<td>(800) 283-1486</td>
<td><a href="http://www.wclib.org">www.wclib.org</a></td>
</tr>
<tr>
<td>WCMA</td>
<td>Window Covering Manufacturers Association</td>
<td>(212) 297-2122</td>
<td><a href="http://www.wcmanet.org">www.wcmanet.org</a></td>
</tr>
<tr>
<td>WDMA</td>
<td>Window &amp; Door Manufacturers Association</td>
<td>(800) 223-2301</td>
<td><a href="http://www.wdma.com">www.wdma.com</a></td>
</tr>
<tr>
<td>WI</td>
<td>Woodwork Institute</td>
<td>(312) 321-6802</td>
<td>(Formerly: WIC - Woodwork Institute of California) <a href="http://www.wicnet.org">www.wicnet.org</a></td>
</tr>
<tr>
<td>WMMPA</td>
<td>Wood Moulding &amp; Millwork Producers Association</td>
<td>(916) 372-9943</td>
<td>(See MMPA)</td>
</tr>
<tr>
<td>WSRCA</td>
<td>Western States Roofing Contractors Association</td>
<td>(800) 725-0333</td>
<td><a href="http://www.wsrca.com">www.wsrca.com</a></td>
</tr>
<tr>
<td>WWPA</td>
<td>Western Wood Products Association</td>
<td>(503) 224-3930</td>
<td><a href="http://www.wwpa.org">www.wwpa.org</a></td>
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</table>

**B. Code Agencies:** Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

- **IAPMO** International Association of Plumbing and Mechanical Officials | (909) 472-4100 | www.iapmo.org
- **ICC** International Code Council | (888) 422-7233 |
PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION
SECTION 01 4 30
QUALITY CONTROL AND TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 TESTING LABORATORY SERVICES

A. Contractor shall retain an independent testing laboratory, acceptable to the Owner, to perform their Work called for in the Specifications, and pay cost of services.

B. Contractor shall furnish samples for such tests and deliver them to the testing agency as directed by the Owner.

C. The testing laboratory shall distribute copies of reports as follows:
   1. 2 copies to the Owner
   2. 1 copy to the Civil Engineer
   3. 2 copies to the Contractor

D. Costs for retesting required due to Contractor's failure to comply with specified requirements shall be paid for by the Contractor.

E. The following list is intended as a guide to the Contractor to aid in the determining testing requirements for the project, however, the requirements specified in the technical sections shall take precedence over this list and this list is not to be interpreted as being complete.
   1. 02300 - Earthwork: Test imported fill materials if required, observation of earthwork by Geotechnical Engineer, density and moisture testing of trench backfill, field density tests of underslab fill and backfill.
   2. 02740 - Asphaltic Concrete Paving: Smoothness tests
   3. 03300 - Cast-In-Place Concrete: Test cylinders, slump test(s)

1.2 CONTRACTOR'S QUALITY CONTROL

A. Where Specifications require that a particular product be installed and/or applied by an Applicator approved by the Manufacturer, it is the Contractor's responsibility to ensure that Subcontractor employed for such Work is approved. Such Subcontractor(s) shall provide evidence of being approved when requested by the Architect.

B. Work shall be executed by mechanics skilled in the Work required. Conform to the methods, standards and accepted practices of the Trade or Trades involved.

PART 2 - PRODUCTS – NOT USED.

PART 3 - EXECUTION – NOT USED.

END OF SECTION
SECTION 01 4 30
QUALITY CONTROL

PART 1 - GENERAL

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END OF SECTION
SECTION 01453
CODE-REQUIRED SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Code-required special inspections.
B. Testing services incidental to special inspections.
C. Submittals.
D. Manufacturers' field services.
E. Fabricators' field services.

1.2 RELATED REQUIREMENTS:

A. Section 01330 – Submittal Procedures: Submittal requirements.
B. Section 01400 - Quality Requirements.
C. Section 01420 - References.
D. Section 01600 - Product Requirements: Requirements for material and product quality.

1.3 DEFINITIONS:

B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
C. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
   2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.4 REFERENCE STANDARDS:

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2015.
G. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2012.
N. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014.
R. ASTM E2174 - 14 - Standard Practice for On-Site Inspection of Installed Firestops.
U. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2011 w/Errata.
Y. IAS AC291 - Accreditation Criteria for Special Inspection Agencies; 2012.

1.5 SUBMITTALS:
A. See Section 01330 - Submittal Procedures. for submittal requirements.
B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
   1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Special Inspection Agency is acceptable to AHJ.

C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Submit certification that Testing Agency is acceptable to AHJ.

D. Smoke Control Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
   1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit documentary evidence that agency has appropriate credentials and documented experience in fire protection engineering, mechanical engineering and HVAC air balancing.
   3. Submit certification that Testing Agency is acceptable to AHJ.

E. Manufacturer's Qualification Statement: Manufacturer shall submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.

F. Fabricator's Qualification Statement: Fabricator shall submit documentation of fabrication facilities and methods as well as quality control procedures. Include documentation of AHJ approval.

G. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit three copies of report; one to Architect, one to Engineer of Record and one to the AHJ. Include:
   1. a. Date issued.
   2. b. Project title and number.
   3. c. Name of Special Inspector.
   4. d. Date and time of special inspection.
   5. e. Identification of product and specifications section.
   6. f. Location in the Project.
   7. g. Type of special inspection.
   8. h. Date of special inspection.
   9. i. Results of special inspection.
   2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work. Refer to Section 00 63 42 for form.

H. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator’s facility, Special Inspector shall promptly submit three copies of report; one to Architect, one to Engineer of Record and one to AHJ. Include:
   1. a. Date issued.
   b. Project title and number.
   c. Name of Special Inspector.
d. Date and time of special inspection.
e. Identification of fabricated item and specification section.
f. Location in the Project.
g. Results of special inspection.
h. Verification of fabrication and quality control procedures.
i. Conformance with Contract Documents.
j. Conformance to referenced standard(s).

I. Test Reports: After each test or inspection, promptly submit three copies of report; one to
Architect, one to Engineer of Record and one to AHJ.
1. Include:
   a. Date issued.
   b. Project title and number.
   c. Name of inspector.
   d. Date and time of sampling or inspection.
   e. Identification of product and specifications section.
   f. Location in the Project.
   g. Type of test or inspection.
   h. Date of test or inspection.
   i. Results of test or inspection.
   j. Conformance with Contract Documents.
2. Refer to Section 00 63 42 for form.

J. Certificates: When specified in individual special inspection requirements, Special Inspector
shall submit certification by the manufacturer, fabricator, and installation subcontractor to
Architect and AHJ, in quantities specified for Product Data.
1. Indicate material or product conforms to or exceeds specified requirements. Submit
   supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be
   acceptable to Architect and AHJ.

K. Manufacturer's Field Reports: Submit reports to Architect and AHJ.
1. Submit report in duplicate within 30 days of observation to Architect for information.
2. Submit for information for the limited purpose of assessing conformance with
   information given and the design concept expressed in the contract documents.

L. Fabricator's Field Reports: Submit reports to Architect and AHJ.
1. Submit report in duplicate within 30 days of observation to Architect for information.
2. Submit for information for the limited purpose of assessing conformance with
   information given and the design concept expressed in the contract documents.

1.6 SPECIAL INSPECTION AGENCY:
A. Owner will employ services of a Special Inspection Agency to perform inspections and
   associated testing and sampling required by the building code.

B. The Special Inspection Agency may employ and pay for services of an independent testing
   agency to perform testing and sampling associated with special inspections and required by the
   building code.

C. Employment of agency in no way relieves Contractor of obligation to perform work in
   accordance with requirements of Contract Documents.

1.7 TESTING AND INSPECTION AGENCIES:
A. Owner or Architect may employ services of an independent testing agency to perform additional
   testing and sampling associated with special inspections but not required by the building code.
B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.8 QUALITY ASSURANCE:

A. Special Inspection Agency Qualifications:
1. Independent firm specializing in performing testing and inspections of the type specified in this section.
2. Accredited by IAS according to IAS AC291.

B. Testing Agency Qualifications:
1. Independent firm specializing in performing testing and inspections of the type specified in this section.
2. Accredited by IAS according to IAS AC89.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL:

A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
1. Continuous Special Inspection: Special Inspection Agency shall be present in the area where the work is being performed and observe the work at all times the work is in progress.
2. Periodic Special Inspection: Special Inspection Agency shall be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.2 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION:

A. High-Strength Bolt, Nut and Washer Material:
1. Verify identification markings conform to ASTM standards specified in the approved contract and to AISC 360, A3.3; periodic.
2. Submit manufacturer's certificates of compliance; periodic.

B. High-Strength Bolting Installation: Verify items listed below comply with AISC 360, Section M2.5.
1. Snug tight joints; periodic.
2. Pretensioned and slip-critical joints with matchmarking, twist-off bolt or direct tension indicator method of installation; periodic.
3. Pretensioned and slip-critical joints without matchmarking or calibrated wrench method of installation; continuous.

C. Structural Steel and Cold Formed Steel Deck Material:
1. Structural Steel: Verify identification markings conform to AISC 360, Section M3.5; periodic.
2. Other Steel: Verify identification markings conform to ASTM standards specified in the approved contract documents; periodic.
3. Submit manufacturer's certificates of compliance and test reports; periodic.

D. Weld Filler Material:
1. Verify identification markings conform to AWS standards specified in the approved contract documents and to AISC 360, A3.5; periodic.
2. Submit manufacturer's certificates of compliance; periodic.
E. Welding:
1. Structural steel and cold formed steel deck:
   a. Complete and partial joint penetration groove welds: Verify compliance with AWS D1.1/D1.1M; continuous.
   b. Multipass fillet welds: Verify compliance with AWS D1.1/D1.1M; continuous.
   c. Single pass fillet welds less than 5/16 inch wide: Verify compliance with AWS D1.1; periodic.
   d. Plug and slot welds: Verify compliance with AWS D1.1/D1.1M; continuous.
   e. Single pass fillet welds 5/16 inch or greater: Verify compliance with AWS D1.1/D1.1M; continuous.
   f. Floor and roof deck welds: Verify compliance with AWS D1.3/D1.3M; continuous.
2. Reinforcing Steel: Verify items listed below comply with AWS D1.4 and ACI 318, Section 3.5.2.
   a. Verification of weldability; periodic.
   b. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames as well as boundary elements of special structural walls of concrete and shear reinforcement; continuous.
   c. Shear reinforcement; continuous.
   d. Other reinforcing steel; periodic.

F. Steel Frame Joint Details: Verify compliance with approved contract documents.
1. Details, bracing and stiffening; periodic.
2. Member locations; periodic.
3. Application of joint details at each connection; periodic.

G. Cold formed steel trusses spanning 60 feet or more; periodic.

3.3 SPECIAL INSpections for concrete construction:
A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved contract documents and ACI 318, 3.5 and 7.1 through 7.7; periodic.
B. Reinforcing Steel Welding: Verify compliance with AWS D1.4 and ACI 318, 3.5.2; periodic.
C. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved contract documents and ACI 318, 8.1.3 and 21.2.8 prior to and during placement of concrete; continuous.
D. Anchors Installed in Hardened Concrete: Verify compliance with ACI 318, 3.8.6, 8.1.3 and 21.2.8; periodic.
E. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with ACI 318, Chapter 4 and 5.2; periodic.
F. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172, ASTM C31 and ACI 318, 5.6 and 5.8 and record the following, continuous:
   1. Slump.
   2. Air content.
   3. Temperature of concrete.
G. Concrete and Shotcrete Placement: Verify application techniques comply with approved contract documents and ACI 318, 5.9 and 5.10; continuous.
H. Specified Curing Temperature and Techniques: Verify compliance with approved contract documents and ACI 318, 5.11 through 5.13; periodic.
I. Prestressed Concrete: Verify compliance with approved contract documents; continuous.

J. Precast Concrete Members: Verify erection techniques and placement comply with approved contract documents and ACI 318, Chapter 16; periodic.

K. Concrete Strength in Situ: Verify concrete strength complies with approved contract documents and ACI 318, 6.2, for the following.
   1. Prestressed members, prior to stressing of tendons; periodic.
   2. Beams and structural slabs, prior to removal of shores and forms; periodic.

L. Formwork Shape, Location and Dimensions: Verify compliance with approved contract documents and ACI 318, 6.1.1; periodic.

M. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials conform to the quality standards of ACI 318, the AHJ will require that the Special Inspector verify compliance with the appropriate standards and criteria in ACI 318, Chapter 3.

3.4 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION

A. Verify each item below complies with approved contract documents and the applicable articles of ACI 530/530.1/ERTA.
   1. Inspections and Approvals:
      a. Verify compliance with the required inspection provisions of the approved contract documents; periodic.
      b. Verify approval of submittals required by contract documents; periodic.
   2. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.
   4. Joints and Accessories: When masonry construction begins, verify:
      a. Proportions of site prepared mortar; periodic.
      b. Construction of mortar joints; periodic.
      c. Location of reinforcement, connectors, prestressing tendons, anchorages, etc.; periodic.
   5. Structural Elements, Joints, Anchors, Protection: During masonry construction, verify:
      a. Size and location of structural elements; periodic.
      b. Type, size and location of anchors, including anchorage of masonry to structural members, frames or other construction; periodic.
      c. Size, grade and type of reinforcement, anchor bolts and prestressing tendons and anchorages; periodic.
      d. Welding of reinforcing bars; continuous.
   6. Grouting Preparation: Prior to grouting, verify:
      a. Grout space is clean; periodic.
      b. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; periodic.
      c. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
      d. Correctly constructed mortar joints; periodic.
3.5 SPECIAL INSPECTIONS FOR SPRAYED FIRE RESISTANT MATERIALS:

A. Sprayed Fire Resistant Materials, General:
   1. Verify compliance of sprayed-fire resistant materials with specific fire-rated assemblies shown in the approved contract documents, and with the applicable requirements of the building code.
   2. Perform special inspections after rough installation of electrical, mechanical, plumbing, automatic fire sprinkler and suspension systems for ceilings.

B. Physical and visual tests: Verify compliance with fire resistance rating.
   1. Condition of substrates; periodic.
   2. Thickness of sprayed fire resistant material; periodic.
   3. Density of sprayed fire resistant material in pounds per cubic foot; periodic.
   4. Bond strength (adhesion and cohesion); periodic.
   5. Bond strength (cohesion); periodic.
   6. Condition of finished application; periodic.

C. Structural member surface conditions:
   1. Inspect structural member surfaces before application of sprayed fire resistant materials; periodic.
   2. Verify preparation of structural member surfaces complies with approved contract documents and manufacturer's written instructions; periodic.

D. Application:
   1. Ensure minimum ambient temperature before and after application complies with the manufacturer's written instructions; periodic.
   2. Verify area where sprayed fire resistant material is applied is ventilated as required by the manufacturer's written instructions during and after application; periodic.

E. Thickness: Verify that no more than 10 percent of thickness measurements taken from sprayed fire resistant material are less than thickness required by fire resistance design in approved contract documents. In no case shall the thickness of the sprayed fire resistant material be less than the minimum below.
   1. Minimum Allowable Thickness: Tested according to ASTM E605, periodic.
      a. Design thickness 1 inch or greater: Design thickness minus 1/4 inch.
      b. Design thickness greater than 1 inch: Design thickness minus 25 percent.
   2. Floor, Roof and Wall Assemblies: Test thickness according to ASTM E605 with no less than four measurements per 1,000 square feet of sprayed area on each story of the structure or portion thereof; periodic.
      a. Cellular Decks: Measure thickness within a single 12 inch by 12 inch area. Make a minimum of four measurements arranged symmetrically in testing area.
      b. Fluted Decks: Measure thickness within a single 12 inch by 12 inch area. Make a minimum of four measurements arranged symmetrically in testing area and include one example each of valley, crest and sides. Report the average of the four measurements.
   3. Structural Members: Test according to ASTM E605. Test no less than 25 percent of structural members on each story of the structure or portion thereof; periodic.
      a. Beams and girders: Make nine thickness measurements around beam or girder at each end of a 12 inch by 12 inch length.
      b. Joists and trusses: Make seven thickness measurements around joist or truss at each end of a 12 inch by 12 inch length.
      c. Wide flanged columns: Make twelve thickness measurements around column at each end of a 12 inch by 12 inch length.
      d. Hollow structural sections and pipe columns: Make four thickness measurements around hollow structural section or pipe column at each end of a 12 inch by 12 inch length.
F. Density: Verify density of sprayed fire resistant material is no less than density required by the fire resistance design in the approved contract documents.
   1. Floor, Roof and Wall Assemblies: Test according to ASTM E605 with no less than one sample per 2,500 square feet of sprayed area on each story of the structure or portion thereof; periodic.
   2. Beams, Girders, Trusses and Columns: Test according to ASTM E605 with no less than one sample per 2,500 square feet of sprayed area on each story of the structure or portion thereof; periodic.

G. Bond Strength: Verify adhesive and cohesive bond strength of sprayed fire resistant materials is no less than 150 pounds per square foot when in-place samples of the cured material are tested according to ASTM E736 and as described below.
   1. Floor, roof and wall assemblies: Test no less than one sample per each 2,500 square feet of sprayed area on each story of the structure or portion thereof; periodic.
   2. Structural members: Test no less than one sample from each type of structural member in each 2,500 square feet of each story of the structure or portion thereof; periodic.
   3. Primer, paint and encapsulant bond tests: When sprayed fire-resistant material is applied to a primed, painted or encapsulated surface for which acceptable material to substrate performance has not been determined, conduct bond test.

H. Patching:
   1. The Special Inspector shall observe that corrective measures have been applied to areas requiring re-spraying or patching where materials have been deliberately removed for testing, been damaged, or removed by other trades.

3.6 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS (IBC 1705.16):

A. Verify penetration firestops in accordance with ASTM E2174.

B. Verify fire resistant joints in accordance with ASTM E2393.

C. For Penetration Firestop Systems, General:
   1. Verify the documents and submitted drawings reference tested and listed applicable through and membrane penetration assemblies containing sealants, devices and/or other materials tested to ASTM E814 or UL 1479 by accredited testing agencies. These systems should be published and readily available via the internet or other means.
   2. Verify that the Through-Penetration System being used has been tested to the hourly rating necessary (i.e. 1 hr., 2 hr., etc..) based on the type of assembly being penetrated.
   3. Verify compliance of fire resistant penetration and joint materials with specific fire-rated assemblies shown in the approved contract documents, and with the applicable requirements of the building code.
   4. Perform special inspections after rough installation of electrical, mechanical, plumbing, automatic fire sprinkler and suspension systems for ceilings.

D. Physical and visual tests: Verify compliance with fire-resistance rating.
   1. Penetration firestops; periodic. Listed systems shall be inspected in accordance with ASTM E2393.
   2. Fire-Resistant joint systems; periodic. Listed systems shall be inspected in accordance with ASTM E2393.

E. Firestopping shall be installed by an FM 4991 Approved Firestop Contractor and/or UL Qualified Firestop Contractor. The installer shall issue to AHJ or Owner a Certificate of Conformance confirming that the work has been carried out in accordance with specifications.

G. Through-penetration firestop systems, concealed draftstop and fireblock systems. All through-penetration firestopping, draftstopping and fireblocking shall be subject to periodic special inspection prior to concealment to determine compliance with the approved construction documents. Listed systems shall be inspected for compliance with their listing.

1. Exception: Through-penetration firestop systems may be inspected in accordance with ASTM E2174-14 when authorized by the registered design professional of record and when the contractor applies the procedures established in that standard.

H. In accordance with ASTM E2174 and ASTM E2393 conflict-of-interest guidelines, inspections, including destructive testing, shall not be performed by installers, manufacturers, or suppliers, or competitors of any of these entities, of the material being inspected.

I. For Fire Resistive Joint Systems: Including Mechanical Fire Barrier Systems:

1. Verify the documents and submitted drawings reference tested and listed fire resistive joint systems tested to ASTM E1966 or UL 2079 by accredited testing laboratories or certified third party testing agencies. These systems should be published or readily available via the internet or other means.

2. Verify the documents and submitted drawings have been reviewed by the Project Design Professional and/or the structural engineer and that they meet the allowable movement requirements.

3. Verify the documents and submitted drawings reference systems that have been tested for the required amount of movement. A system listing a nominal 1 inch joint width with 25% compression or extension, actually allows for a movement of 1/4” of compression and 1/4” of extension.

4. Verify the rating of the joint system is equal to the rating of the assemblies it is connecting. The code requires that the rating of a joint system shall not be less than the fire resistive ratings of the adjacent assemblies.

J. For Perimeter Fire Barrier Systems (Curtain Walls):

1. Verify documents and submitted drawings reference legitimate listed Perimeter Fire Barrier Systems. Documents referencing only fire resistive joint systems such as FF, FW or HW should not be accepted for curtain wall applications.

2. Verify the rating of the system is greater than or equal to the rating of the floor. The continuity requirements within the building codes state that the rating of a floor assembly must extend to and be tight against an exterior wall.

3. Verify that the firestop material to be used is classified and listed for use in Perimeter Fire Barrier Systems. All other materials should not be used.

4. Verify documents reference systems that have been tested with windows or vision glass if the building has glazing close to the safing area. Some systems were tested with glazing close to the safing area while other systems were for structures with limited glazing such as storage and warehouse facilities.

5. Verify a stiff steel reinforcement member, if required, has been placed behind exposed curtain wall panel insulation. Typical stiffening members can be steel hat channels, “L” or “T” angles.

6. Verify insulation type and brand used is listed within the tested system. Mineral wool is the typical insulation of choice. If mineral wool is used it must be installed to the correct compression and according to the correct orientation.

7. If required by the tested system, verify insulation panels are securely fastened with mechanical fasteners per the listed system.

8. Verify that exposed mullions, if required by the system, are covered with the proper insulating barrier securely fastened with mechanical fasteners per the system design.

9. Verify safing clips or “Z” clips have been used if the system requires it.
10. Verify coating or sealant has been applied to the proper depth. A common inspection practice is to be on site just prior to the addition of the sealant to verify the correct application thickness is being followed and to verify correct orientation of mineral wool. The inspector may request samples from the installing contractor after which the installing contractor shall make the necessary repairs to the destructively sampled area. A scale or caliper is sufficient for measuring the sealant depth.

K. For Fire-Resistance-Rated Duct Enclosure Systems:
   1. Verify the documents and submitted drawings reference legitimate fire resistive duct enclosure systems tested by accredited testing laboratories or certified third party testing agencies. These systems and insulation components should be listed, labeled, published and readily available via the internet or other means.
   2. Verify the duct enclosure system is tested to the appropriate Standard for the specific type of duct system. Grease duct enclosure systems are tested and listed per ASTM E2336, which includes a full scale ASTM E 119 engulfment test. HVAC duct enclosure systems are tested and listed per ISO 6944, Type A is for closed duct systems and Type B is for duct systems that contain openings.
   3. Verify the fire resistance rating of the duct enclosure system and corresponding firestop system are equal or greater than the required fire resistance ratings for the building construction assembly penetrated. For grease ducts, the IMC requires the fire resistance rating of the duct enclosure system be at least equivalent to the surrounding building construction assembly penetrated. The F and T ratings for the corresponding duct firestop system must also be at least equivalent to the duct enclosure system and the surrounding assembly. For HVAC ducts, the stability, integrity and fire resistance rating of the duct enclosure system must be at least equivalent to the rating of the construction assembly penetrated.
   4. Verify the field installation is consistent with the parameters of the listing and therefore compliant.
      a. Duct System Type - kitchen grease exhaust, hazardous material exhaust, ventilation, supply/return, etc.
      b. Duct Construction - dimensions, material, gauge, reinforcement, connections, vertical or horizontal orientation.
      c. Enclosure System - labeled components, number of layers, fire rating, required clearance to combustibles, thickness and density of material, material joints (overlap of material, taping of cut edges or seams), etc.
      d. Enclosure System Attachment - mechanical method of attachment to duct (typically steel banding and/or capacitor discharge insulation pins), components, spacing, gauge, etc.
      e. Duct Supports - hanger system components, frequency of location, clearance to enclosure system, protection requirements.
      f. Access Door - field fabricated or prefabricated door construction and protection with enclosure system material must match design listing.
      g. Firestop System - refer to design listing for fire rated assembly construction, annular space, packing material type and depth, and firestop material type and depth.

L. Destructive testing of firestop systems shall be conducted in the following manner:
   1. Multiple locations shall be measured within a given application to provide evidence of compliance.
   2. For verification of sealant depth, measurements shall be made at all points of adhesion rather than towards the center of the seal.
   3. For systems incorporating integral packing or forming materials, verify proper type, density, compression, orientation of fiber, and depth.
4. For sealants or coatings applied in joint systems and perimeter fire barrier systems, take measurements within a 12 inch (305 mm) sample for every 500 lineal feet (152 m), or as dictated by project specifications or client request. Within the 12 inch (305 mm) sample section, measure the thickness in eight (8) places. Measure the points of adhesion on each end of the sample and also on 4 inch (102 mm) centers.

5. For sealants or coatings applied in penetration firestop systems, perform measurements on a given penetration system as follows:
   a. Penetrations that are nominal 6 inches (152 mm) in diameter and larger shall be measured in four quadrants, to give eight independent thickness measurements.
   b. Penetrations that are nominal less than 6 inches (152 mm) but greater than 2 inches (51 mm) in diameter shall be measured in three quadrants, to give six independent thickness measurements.
   c. Penetrations that are nominal 2 inches (51 mm) or less in diameter shall be measured in two quadrants, to give four independent thickness measurements.
   d. For third-party listed and labeled pre-formed firestop devices, factors including appropriate fasteners, rigid attachments, and visual verification of fully-intact device may be necessary at the discretion of the inspector.

3.7 SPECIAL INSPECTIONS FOR SMOKE CONTROL:
   A. Test smoke control systems as follows:
      1. Record device locations and test system for leakage after erection of ductwork but before starting construction that conceals or blocks access to system.
      2. Test and record pressure difference, flow measurements, detection function and controls after system is complete and before structure is occupied.

3.8 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE:
   A. Structural Steel: Comply with the quality assurance plan requirements of AISC 341.
   B. Cold Formed Steel Light Frame Construction:
      1. Field welding; periodic.
      2. Screw attachment, bolting, anchoring and other fastening of components within the main seismic force-resisting system; periodic.
   C. Architectural Components: Erection and fastening of components below; periodic.
      1. Exterior cladding.
      2. Interior and exterior veneer.
      3. Interior and exterior non-loadbearing walls and partitions.
   D. Mechanical and Electrical Components:
      1. Anchorage of electric equipment required for emergency or standby power systems; periodic.
      2. Installation and anchorage of other electrical equipment; periodic.
      3. Installation of piping systems for flammable, combustible or highly-toxic contents and associated mechanical units; periodic.
      4. Installation of HVAC ductwork that will contain hazardous materials; periodic.
      5. Vibration isolation systems where the approved contract documents require a nominal clearance of 1/4 inch or less between support frame and seismic restraint; periodic.
   E. Designated Seismic System Verification: Verify label, anchorage or mounting conforms to certificate of compliance provided by manufacturer or fabricator.
   F. Seismic Isolation System:
      1. Fabrication and installation of isolator units; periodic.
      2. Fabrication and isolation of energy dissipation devices; periodic.
G. Structural Testing for Seismic Resistance:
   1. Concrete reinforcement: Comply with ACI 318, Section 21.1.5.2.
      a. Materials Obtain mill certificates demonstrating compliance with ASTM
         A615/A615M; periodic.
      b. Welding: Perform chemical tests complying with ACI 318, Section 3.5.2 to
determine weldability; periodic.
   2. Structural Steel: Comply with the quality assurance requirements of AISC 341.
   3. Non-Structural Components:
      a. General Design Requirements: Obtain manufacturer certification of compliance
         with requirements of ASCE 7, Section 13.2.1; periodic.
      b. Designated Seismic Force-Resisting Non-Structural System Components:
         Obtain manufacturer certification of compliance with ASCE 7, Section 13.2.2;
         periodic.
   4. Seismically Isolated Structures: Test system in accordance with ASCE 7, Section 17.8

H. Structural Observations for Seismic Resistance: Visually observe structural system for general
conformance with the approved contract documents; periodic.

3.9 SPECIAL INSPECTIONS FOR WIND RESISTANCE:

A. Cold Formed Steel Light Frame Construction:
   1. Field welding; periodic.
   2. Screw attachment, bolting, anchoring and other fastening of components within the
      main wind force-resisting system; periodic

B. Wind Resisting Components:
   1. Roof cladding; periodic.
   2. Wall cladding; periodic.

C. Structural Observations for Wind Resistance: Visually observe structural system for general
conformance with the approved contract documents; periodic.

3.10 OTHER SPECIAL INSPECTIONS:

A. Provide for special inspection of work that, in the opinion of the AHJ, is unusual in nature.

B. For the purposes of this section, work unusual in nature includes, but is not limited to:
   1. Construction materials and systems that are alternatives to materials and systems
      prescribed by the building code.
   2. Unusual design applications of materials described in the building code.
   3. Materials and systems required to be installed in accordance with the manufacturer's
      instructions when said instructions prescribe requirements not included in the building
      code or in standards referenced by the building code.

C. Alternative Test Procedures: Where approved rules and standards do not exist, test materials
and assemblies as required by AHJ or provide AHJ with documentation of quality and manner in
which those materials and assemblies are used.

D. Load Tests:
   1. Proposed Construction and Construction in Progress: Where required by code, conduct
tests listed below.
      a. Load test procedures specified in code; periodic.
      b. Load test procedures not specified in code; periodic.
      c. Loadbearing Wall and Partition Assemblies: Load test with and without window
         framing; periodic.
      d. Exterior Window and Door Assemblies: Wind load design pressure test;
         periodic.
2. Completed Construction: Where required by code, conduct tests listed below.
   a. Load test procedures specified in code; periodic.
   b. Load test procedures not specified in code; periodic.

3.11 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES:

A. Special Inspection Agency shall:
   1. Verify samples submitted by Contractor comply with the referenced standards and the
      approved contract documents.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in
      performance of services.
   3. Perform specified sampling and testing of products in accordance with specified
      reference standards.
   4. Ascertain compliance of materials and products with requirements of Contract
      Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-conformance
      of work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Attend preconstruction meetings and progress meetings.
   8. Submit reports of all tests or inspections specified.

B. Limits on Special Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract
      Documents.
   2. Agency may not approve or accept any portion of the work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the work.

C. Re-testing required because of non-conformance to specified requirements shall be performed
   by the same agency on instructions by Architect.

D. Re-testing required because of non-conformance to specified requirements shall be paid for by
   Contractor.

3.12 TESTING AGENCY DUTIES AND RESPONSIBILITIES:

A. Testing Agency Duties:
   1. Test samples submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in
      performance of services.
   3. Perform specified sampling and testing of products in accordance with specified
      standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-conformance
      of work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Attend preconstruction meetings and progress meetings.
   8. Submit reports of all tests or inspections specified.

B. Limits on Testing or Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract
      Documents.
   2. Agency may not approve or accept any portion of the work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the work.
C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.

D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.13 CONTRACTOR DUTIES AND RESPONSIBILITIES:

A. Contractor Responsibilities, General:
1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
2. Cooperate with agency and laboratory personnel; provide access to the work, to manufacturers’ facilities, and to fabricators’ facilities.
3. Provide incidental labor and facilities:
   a. To provide access to work to be tested or inspected.
   b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
   c. To facilitate tests or inspections.
   d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

B. Contractor Responsibilities, Seismic Force-Resisting Systems: Submit written statement of responsibility for each item listed to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

C. Contractor Responsibilities, Wind Force-Resisting Systems: Submit written statement of responsibility for each item listed to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

3.14 MANUFACTURERS’ AND FABRICATORS’ FIELD SERVICES:

A. When specified in individual specification sections, require material suppliers, assembly fabricators, or product manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, to test, adjust, and balance equipment, and to initiate instructions when necessary.

B. Submit qualifications of observer to Architect and Engineer of Record 30 days in advance of required observations.
1. Observer subject to approval of Architect and Engineer of Record.
2. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary lighting.
   3. Temporary heating.
   4. Temporary cooling.
   5. Temporary ventilation.
   6. Telephone/DSL Communications service
   7. Facsimile service.
   8. Temporary water service.

B. Construction Facilities:
   1. Field offices and sheds.
   2. Vehicular access.
   3. Parking.
   4. Progress cleaning and waste removal.
   5. Project identification.

C. Temporary Controls:
   1. Barriers.
   2. Enclosures and fencing.
   4. Water control.
   5. Dust control.

D. Removal of utilities, facilities, and controls

1.2 GENERAL:

A. Comply with codes and regulations regarding potable drinking water, sanitation, dust control, fire protection, and other temporary controls.

B. Interruptions of the utility service to the existing property is not permitted. However, in the event such interruption is needed, obtain written approval from the Owner's Representative a minimum of 72 hours prior to disconnection or shutting off any service or utility. Contractor shall notify Owner of any planned interruption of utilities and services in writing.

C. Remove all temporary facilities and construction from the site as soon as practical and possible and in the opinion of the Owner's Representative the progress of the work deems it practical.

D. Restore and refurbish the areas of the site occupied by the temporary facilities to a form acceptable to the Architect and the Owner's Representative.

1.3 TEMPORARY ELECTRICITY:

A. Cost: By Owner, connect to Owner's existing power service where designated on the drawings.
B. Do no disrupt Owner's need for continuous service.

C. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required.

D. Provide separate generators or other power source for equipment with special power requirements not available from the Owner's service.

1.4 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES:

A. Provide and maintain lighting for construction operations.

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

C. Maintain lighting and provide routine repairs.

D. Permanent building lighting may be utilized during construction.

1.5 TEMPORARY HEAT:

A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

B. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

C. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and construction filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.6 TEMPORARY COOLING:

A. Cost of Energy: By Owner.

B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
1. Replace all filters immediately prior to the issuance of the Certificate of Temporary Occupancy.

1.7 TEMPORARY VENTILATION:

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
1.8 TELEPHONE / COMMUNICATION SERVICE:
A. Provide, maintain and pay for telecommunication services to field office at time of project mobilization.
B. Telecommunications services shall include:
   1. Facsimile Service: Minimum of one dedicated fax machine/printer, with dedicated phone line.
   2. WIFI connection: High speed/ broad band internet service shall be provided.

1.9 TEMPORARY WATER SERVICE:
A. Connect to existing water source for construction operations.
B. Do no disrupt Owner's need for continuous service.

1.10 TEMPORARY SANITARY FACILITIES:
A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.11 TEMPORARY FIRE PROTECTION:
A. Provide the required quantity of fire extinguishers, UL labeled ABC all-purpose for protection of the Work.
B. Provide temporary field office, storage and sheds with required fire extinguishers.
C. Comply with fire insurance and governing agencies.

1.12 WATER CONTROL
A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.13 DUST CONTROL
A. Execute Work by methods to minimize raising dust from construction operations.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

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

D. Provide temporary traffic control signs to direct construction traffic, staff traffic and public traffic to designated areas during the course of construction.

E. Design, location, layout and construction of all barricades and cover walkways shall be approved by the Owner prior to construction.

1.15 FENCES AND ENCLOSURES:

A. Construction: Temporary commercial grade chain link fence.

B. Provide 6 feet high fence around construction site; equip with vehicular gates with locks.

C. Exterior: Provide temporary weather tight closure of exterior openings in existing buildings to accommodate acceptable working conditions and protection for Products and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

D. Interior: Provide temporary partitions and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

1. For Work within and existing, occupied facility:
   a. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.
   b. All temporary partitions to be finished on the public side with gypsum board, taped, finished and painted white.
   c. Interior barriers that cross finished flooring shall not be anchored through the flooring material but shall be held in place with weights such as sandbags to provide support without damaging surfaces.

1.16 PROTECTION OF INSTALLED WORK:

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

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

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

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

E. Provide protection for plants designated to remain. Replace damaged plants.

1.17 SECURITY:

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

B. Coordinate with Owner’s security operations and programs.

1.18 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Restrict site access and parking to areas designated by the Owner.

E. Provide means of removing mud from vehicle wheels before entering streets.

F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

G. Existing parking areas located at ______ may be used for construction parking.

H. Maintenance:
   1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
   2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

I. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.19 PROGRESS CLEANING AND WASTE REMOVAL:

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 rubbish from site weekly at a minimum and more frequently as needed and dispose off-site.

1.20 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS:

A. Remove temporary utilities, equipment, facilities, and materials prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.21 PROJECT IDENTIFICATION:

A. Project Identification Sign:
   1. Provide one painted sign, 32 sq. ft. in area, bottom 6 feet above ground.
   2. Content:
      a. Project title, logo and name of Owner as indicated on Contract Documents.
      b. Names and titles of authorities.
      c. Names and titles of Architect/Engineer and Consultants.
      d. Name of Prime Contractor.
4. No other signs are allowed without Owner permission except those required by law.

B. Sign Painter: Experienced as professional sign painter.

C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

D. Show content, layout, lettering, color, foundation, structure, sizes, and grades of members.

E. Sign Materials:
   2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inches thick, standard large sizes to minimize joints.
   3. Rough Hardware: Galvanized.
   4. Paint and Primers: Exterior quality, two coats; sign background color as selected.
   5. Lettering: Exterior quality paint, contrasting colors as selected.

F. Installation:
   1. Install project identification sign within 30 days after date fixed by Notice to Proceed.
   2. Erect at location of high public visibility adjacent to main entrance to site.
   3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
   4. Install sign surface plumb and level, with butt joints. Anchor securely.
   5. Paint exposed surfaces of sign, supports, and framing.

G. Maintenance: Maintain signs and supports clean, repair deterioration and damage.

H. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:
   A. Cleaning and disposal of waste materials, debris, and rubbish during construction.

1.2 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. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.
   E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
      1. Aluminum and plastic beverage containers.
      2. Corrugated cardboard.
      3. Wood pallets.
      4. Clean dimensional wood: May be used as blocking or furring.
      5. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
      6. Bricks: May be used on project if whole, or crushed and used as landscape cover, sub-base material, or fill.
      7. Concrete masonry units: May be used on project if whole, or crushed and used as sub-base material or fill.
      8. Precast concrete panels: May be used for erosion control or landscape features.
      9. Asphalt paving: May be recycled into paving for project.
     10. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
      11. Glass.
      12. Gypsum drywall and plaster.
      14. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
      15. Asphalt roofing shingles.
      16. Paint.
      17. Plastic sheeting.
      18. Rigid foam insulation.
      20. Windows, doors, and door hardware.
      22. Mechanical and electrical equipment.
      23. Fluorescent lamps (light bulbs).
F. 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.

G. 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.

1.3 RELATED REQUIREMENTS:

A. Section 01010 – Summary of Work: List of items to be salvaged from the existing building for relocation in project or for Owner.

B. Section 01300 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. Section 01500 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

D. Section 01600 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

E. Section 01700 - Execution Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.4 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, corrosively, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosively, 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.

1.5 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 WASTE MANAGEMENT PROCEDURES:

A. See Section 01010 for list of items to be salvaged from the existing building for relocation in project or for Owner.

B. See Section 01300 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. See Section 01500 for additional requirements related to trash/waste collection and removal facilities and services.

D. See Section 01600 for waste prevention requirements related to delivery, storage, and handling.

E. See Section 01700 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION:

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

B. 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.
C. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Pre-construction meeting.
   2. Regular job-site meetings.

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

E. 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.
   1. Recycling Incentives: Revenues and other incentives for recycling will accrue to Owner.

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

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

END OF SECTION
PART 1 - GENERAL

1.1  SECTION INCLUDES:

A. General product requirements.
B. Product delivery, storage and handling requirements.
C. Existing Products.
D. New Products.
E. Product options.
F. Spare parts and maintenance materials.

1.2  RELATED REQUIREMENTS:

A. Section 01300 - Administrative Requirements:
B. Section 01630 - Product Substitutions.

1.3  GENERAL PRODUCT REQUIREMENTS:

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

1.4  DEFINITIONS:

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.
1.5 SUBMITTALS:

A. Refer to Section 01330 - Submittal Procedures, for additional submittal requirements.

B. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
   1. Submit within 15 days after date of Agreement.
   2. For products specified only by reference standards, list applicable reference standards.

C. 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.

D. 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.

E. 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.

F. Indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.6 QUALITY ASSURANCE:

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
   1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
   2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Reused Products: Materials and equipment previously used in this or other construction, salvaged and refurbished as specified.
   1. Wood fabricated from timber abandoned in transit after harvesting is considered reused, not recycled.
   2. Acceptable Evidence: Information about the origin or source, from Contractor or supplier.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING:

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

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

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

1.8 PRODUCT WARRANTIES:

A. Submittal Time: Comply with requirements in Section 01770 - Closeout Procedures and Submittals.

B. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents. Refer to Section 01 78 36 - Warranties and Bonds.
   1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

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

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS:

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.
E. Specific Products to be reused: The reuse of certain materials and equipment already existing on the project site is required.
   1. See drawings for list of items required to be salvaged for reuse and relocation.
   2. If reuse of other existing materials or equipment is desired, submit substitution request.

2.2 NEW PRODUCTS:

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

B. **DO NOT USE** products having any of the following characteristics:
   1. Made using or containing CFC's or HCFC's.
   2. Made of wood from newly cut old growth timber.
   3. Containing lead, cadmium, asbestos.

C. Where all other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions.
   2. If wet-applied, have lower VOC content.
   3. Are extracted, harvested, and/or manufactured closer to the location of the project.
   4. Have longer documented life span under normal use.
   5. Result in less construction waste.
   6. Are made of vegetable materials that are rapidly renewable.
   7. Are made of recycled materials.
   8. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
   9. If bio-based, other than wood, are or are made of Sustainable Agriculture Network certified products.

D. Provide interchangeable components of the same manufacture for components being replaced.

E. Motors: Refer to Electrical Drawings, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

G. Cord and Plug: Provide minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.3 PRODUCT OPTIONS:

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
B. Products specified by stating that the Contract Documents are based on a Product by a single manufacturer followed by the statement "Equivalent products by the following manufacturers are acceptable":
   1. Select the specified Product or a Product by a named manufacturer having equivalent or superior characteristics to the specified Product and meeting the requirements of the Contract Documents.
   2. If the specified Product is not selected, submit Product Data to substantiate compliance of proposed Product with specified requirements.
   3. The specified Product establishes the required standard of quality.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Article 3.01 of this Specification.

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

E. Products specified by naming one Product followed by the statement "Substitutions: Not permitted": Substitutions will not be allowed.

F. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
   1. Select any Product meeting the specified standard.
   2. Submit Product Data to substantiate compliance of proposed Product with specified requirements.

G. 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.

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

I. Products specified by required performance or attributes, without naming a manufacturer or Product:
   1. Select any Product meeting specified requirements.
   2. Submit Product Data to substantiate compliance of proposed Product with specified requirements.

2.4 SPARE PARTS AND MAINTENANCE MATERIALS:

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site and by the Contractor; obtain receipt prior to final payment.

PART 3 - EXECUTION

3.1 SUBSTITUTION PROCEDURES - REFER TO SECTION 01630 – PRODUCT SUBSTITUTIONS.
3.2 OWNER-FURNISHED PRODUCTS:

A. Refer to Section 01420 - REFERENCES for specific requirements for:
   1. OWNER FURNISHED - OWNER INSTALLED (OFOI) products.
   2. OWNER FURNISHED - CONTRACTOR INSTALLED (OFCI) products.

B. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:
   1. Contractor shall provide a written schedule to the Owner indicating when the Owner Furnished items must be received at the project site to insure the Project completion in accordance with the established schedule. Such dates shall be shown on the schedule.
   2. Review Owner reviewed shop drawings, product data, and samples.
   3. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   4. Handle, store, install and finish products.
   5. Repair or replace items damaged after receipt.

3.3 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.

3.4 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.

B. Store and protect products in accordance with manufacturers’ instructions.
C. Store with seals and labels visible, intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

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

F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

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

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

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

J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

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

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

M. 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 01630
PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Administrative and procedural requirements for substitutions.

1.2 RELATED SECTIONS:

A. Section 01330 – Submittals Procedures.

B. Section 01600 – Product Requirements: for requirements for submitting comparable product submittals for products by listed manufacturers.

C. Section 01700 – Execution Requirements.

1.3 DEFINITIONS:

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

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

C. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
   1. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
   2. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate Contractors that will be necessary to accommodate proposed substitution.
   3. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

D. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

E. Samples, where applicable or requested.
F. Certificates and qualification data, where applicable or requested.

G. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

H. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

I. Research reports evidencing compliance with building code in effect for Project, and applicable code organization.

J. Detailed comparison of Contractor’s construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer’s letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

K. Cost information, including a proposal of change, if any, in the Contract Sum.

L. Contractor’s certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

M. Contractor’s waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

1.5 QUALITY ASSURANCE:

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

1.6 PROCEDURES:

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS:

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

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

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

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

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

   a. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
   b. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   c. Requested substitution does not require extensive revisions to the Contract Documents.
   d. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   e. Substitution request is fully documented and properly submitted.
   f. Requested substitution will not adversely affect Contractor's construction schedule.
   g. Requested substitution has received necessary approvals of authorities having jurisdiction.
   h. Requested substitution is compatible with other portions of the Work.
   i. Requested substitution has been coordinated with other portions of the Work.
   j. Requested substitution provides specified warranty.
   k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION

3.1 SUBSTITUTION SUBMITTAL PROCEDURES:

A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

B. Substitution request must be completed with all required information. Incomplete substitution requests will be returned with no action taken.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

D. Submit 1 copy (electronic) of request for substitution for consideration. Limit each request to one proposed substitution.
E. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.

F. Substitution request does not replace the required submittal. Submittals for any items accepted through the Substitution Request procedure are still required.

3.2 ARCHITECTS ACTION:

A. If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution.

B. Architect will notify Contractor of acceptance or rejection of proposed substitution within:
   1. 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

C. Forms of Acceptance:
   1. Architect's Supplemental Instructions for minor changes in the Work.
   2. Construction Change Directive:
      a. Architect may issue a directive, signed by Owner, instructing Contractor to proceed with a change for subsequent inclusion in a Change Order.
      b. Documentation will describe changes in Work and designate method of determining any change to Contract Sum or Contract Time. Promptly execute change.
   3. Change Orders:
      a. AIA Document G701

D. The Architect will notify Contractor in writing of decision to accept or reject request.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. General procedural requirements governing execution of the Work including, but not limited to, the following:
   2. General installation of products.
   3. Progress cleaning.
   4. Starting and adjusting.
   5. Protecting installed construction.
   6. Correction of the Work.
   7. Adjustment of the Work
   8. Final Cleaning
   9. General requirements for maintenance service.

1.2 RELATED REQUIREMENTS:

A. Section 01010 – Summary of Work.
B. Section 01300 - Administrative Requirements: For Coordination Drawing requirements.
C. Section 01045 - Cutting and Patching:
D. Section 01770 – Closeout Procedures and Submittals:
E. Section 02221 - Selective Building Demolition: For Demolition Firm Qualifications and Pre-Demolition Meetings.
F. Individual Product Specification Sections:
   1. Advance notification to other sections of openings required in work of those sections.
   2. Limitations on cutting structural members.

1.3 PROJECT CONDITIONS

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
B. Dust Control: Refer to Section 01500 - Construction Facilities and Controls.
C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.
   2. Outdoors: Limit conduct of noisy exterior work to hours approved by the Owner's Representative.
   3. Indoors: Limit conduct of noisy interior work to hours approved by the Owner's Representative.

1.4 COORDINATION:

A. Refer to Section 01300 – Administrative Requirements for Coordination of Drawings.
B. Verify all dimensions and conditions at the site.

C. Coordinate the Work of this section with all trades.

D. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

E. Notify affected utility companies and comply with their requirements.

F. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

G. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

H. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

I. Coordinate completion and clean-up of work of separate sections.

J. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

K. All work, including materials and workmanship, shall conform to the requirements of applicable local codes, laws, ordinances, the adopted building codes, ANSI A117.1 - Guidelines for Accessible & Useable Buildings and Facilities, and ADAAG- ADA Accessibility Guidelines for Buildings & Facilities.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Before construction, verify the location and points of connection of utility services.
C. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

D. Acceptance of Conditions:
   1. Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations. Start of work means acceptance of existing conditions.
   2. 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.

E. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

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

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

I. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

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

K. Notify Owner and Architect of discrepancies prior to commencement of Work.

3.2 CONSTRUCTION LAYOUT:

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

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
   2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   3. Inform installers of lines and levels to which they must comply.
   4. Check the location, level and plumb, of every major element as the Work progresses.
   5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
   6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
   7. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
8. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

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

3.3 PROGRESS CLEANING:

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.


2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

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

5. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   a. Remove liquid spills promptly.
   b. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

6. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

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

8. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

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

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

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

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

3.4 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 plastic coverings if possible.

3.5 CORRECTION OF THE WORK:

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01045 - Cutting and Patching.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
   2. Restore permanent facilities used during construction to their specified condition.
   3. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
   4. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
   5. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

3.6 STARTING AND ADJUSTING:

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

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

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

D. Testing, adjusting, and balancing HVAC systems: Refer to Sections 01810 - General Commissioning Requirements and 01815 - Commissioning of HVAC.

3.7 FINAL CLEANING:

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

B. Execute final cleaning prior to Substantial Completion.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

C. Use cleaning materials that are nonhazardous.

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

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

F. Remove tools, construction equipment, machinery, and surplus material from Project site.
G. Clean exposed exterior and interior hard-surfac ed finishes to a dirt-free condition, free of stains, films, and similar foreign substances.
   1. Avoid disturbing natural weathering of exterior surfaces.
   2. Restore reflective surfaces to their original condition.

H. Remove debris and surface dust from limited access spaces, including plenums, shafts, equipment vaults, and similar spaces.

I. Sweep concrete floors broom clean in unoccupied spaces.

J. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer’s recommendations if visible soil or stains remain.

K. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

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

M. Replace filters of operating equipment. Clean exposed surfaces of diffusers, registers, and grills.

N. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

O. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

P. Clean debris from roofs, gutters, downspouts, and drainage systems.

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

R. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

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

T. Clean Owner-occupied areas of work.

U. Provide Project Manager with clean material’s MSDS sheets.

3.8 MAINTENANCE:

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty; whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

3.9 DEMONSTRATION AND INSTRUCTION:

A. See Section 01820 - Demonstration and Training.

END OF SECTION
SECTION 01 7 32
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cutting, fitting and patching, including attendant excavation and backfill required to complete Work, and for:
   1. Making several parts fit together properly.
   2. Uncovering portions of Work to provide for installation of ill-timed Work.
   3. Removing and replacing defective and non-conforming Work.
   4. Removing samples of installed Work required for testing, as directed by Architect.
   5. Providing routine penetrations of non-structural surfaces for installation of piping and electrical conduit.
   6. Attaching new materials to existing remodeling areas.

1.2 SUBMITTALS

A. In advance of executing any cutting or alterations, submit written request to Architect requesting consent to proceed with cutting which affects:
   1. Work of Owner or other trades.
   2. Structural value or integrity of any element of Project.
   3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
   4. Efficiency, operational life, maintenance or safety of operational elements.
   5. Visual qualities of sight-exposed elements.

B. Include in request:
   1. Identification of Project.
   2. Description of affected Work.
   3. Necessity for cutting, alteration or excavation.
   4. Effect of Work of Owner or other trades, or structural or weatherproof integrity of Project.
   5. Description of proposed Work:
      a. Scope of cutting, patching, alteration, or excavation.
      b. Trades which will execute Work.
      c. Products proposed to be used.
      d. Extent of refinishing to be done.
   6. Alternatives to cutting and patching.
   7. Cost proposal, when applicable.
   8. Written permission of trades whose Work will be affected.
C. Submit written notice to Architect designating time Work will be uncovered to provide for observation.

1.3 PAYMENT FOR COSTS

A. Cost caused by ill-timed or defective Work or Work not conforming to Contract Documents, including costs for additional services of Architect and Engineer to be paid by Contractor.

B. Cost of Work done on written instructions of Architect, other than defective or nonconforming Work, will be paid by Owner on approval of written Change Order. Provide written cost proposals prior to proceeding with cutting and patching proposed by Architect.

PART 2 - PRODUCTS

2.1 MATERIALS


PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of Work, including elements subject to movement or damage during cutting and patching, and excavating and backfilling. After uncovering Work, inspect conditions affecting installation of new products and verify procedures with Architect.

B. Report unsatisfactory or questionable conditions in writing to Architect/Engineer. Do not proceed with Work until further instructions are received.

3.2 PREPARATION

A. Provide shoring, bracing and supports as required to maintain structural integrity of Work.

B. Provide devices and methods to protect other portions of Work from damage, including elements which may be exposed by cutting and patching Work. Maintain excavations free from water.

3.3 ERECTION, INSTALLATION AND APPLICATION

A. Performance:

1. Execute fitting and adjustment of products to provide finished installation to comply with and match specified tolerances and finishes.

2. Execute cutting and demolition by methods which prevent damage to other Work to provide proper surfaces to receive installation of repairs and new Work.

3. Execute excavating and backfilling by methods which prevent damage to other Work and settlement as specified in Section 02300.

B. Employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed surfaces and moisture-resistant elements such as roofing, sheet metal, sealants and waterproofing.

2. Sight-exposed finished surfaces.

C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes as shown on Drawings and as specified.

D. Fit Work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces. Conform to fire code requirements for penetrations and maintain integrity of fire walls and ceilings.
E. Restore Work which has been cut or removed. Install new products to provide completed Work in accordance with requirements of Contract Documents and as required to match surrounding areas and surfaces.

F. Refinish entire surfaces as necessary to provide an even, matching finish as follows:

1. Continuous Surfaces: To nearest intersections.
2. Assembly Areas: Refinish entire room area.

END OF SECTION
SECTION 01770
CLOSEOUT PROCEDURES AND SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES:
A. Administrative and procedural requirements for contract closeout including, but not limited to the following: (as part of Set of Manuals & Documents for Commissioning process) Inspection procedures including Pre-Functional Checklists and Pre-Substantial Checklists.
B. Substantial Completion procedures.
C. Closeout requirements for specific construction activities are included in the appropriate Sections in Divisions 1 through 48 and shall be coordinated with this Section.
D. Project Record Documents.
E. Final Acceptance.

1.2 RELATED REQUIREMENTS:
A. Section 01300 - Administrative Requirements:
B. Section 01322 - Photographic Documentation: For submitting final completion construction photographic documentation.
C. Section 01700 - Execution Requirements: For progress and final cleaning of Project site.
D. Section 01782 - Operation and Maintenance Data: For operation and maintenance manual requirements.
E. Section 01780 - Warranties and Bonds.
F. Section 01810 - General Commissioning Requirements: for verification and compilation of data into operation and maintenance manuals.
G. Section 01820 - Demonstration and Training: For requirements for instructing Owner's personnel.
H. Individual Product Sections: Specific requirements for operation and maintenance data.

1.3 CLOSEOUT SUBMITTALS:
A. See Section 01330 - Submittal Requirements, for submittal procedures.
B. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
   1. Provide duplicate, notarized copies of the documents required in the Final Completion and Final Payment article of the General Conditions.
C. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.
D. Operation and Maintenance Data:
1. Refer Section 01782 - Operation and Maintenance Data.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 SUBSTANTIAL COMPLETION:

A. Definition: Substantial Completion is that condition which occurs when the Owner accepts the certification of the Architect that construction is sufficiently complete in accordance with the Contract Documents so that the Project may be occupied for the use for which it is intended.

B. Contractor Notification: When Contractor considers work substantially complete, and after the building commissioning and training, submit written declaration to the Architect that Work or designated portion thereof, is substantially complete. Include list of items to be completed or corrected.

C. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
1. Prepare a list of items to be completed and corrected (Contractor's punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar re-leases.
5. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
6. Prepare and submit: Completed Commissioning Manual including but not limited to - Summary by specification # Record of Approved Submittals and Samples, Project Record Documents (including but not limited to As-Built Record Drawings, As-Built Record Specifications, Operating and Maintenance Manuals, Certification of No Asbestos Products Incorporated in Project, Completed Punch Lists, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
15. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
16. Prior to preliminary Substantial Completion and Inspection - Submit:
   a. Operating and Maintenance Data
   b. Keys and keying schedule
c. Guarantees, Warranties and Bonds

d. Completed pre-substantial completion checklists

D. Preliminary Inspection: Architect will make a preliminary inspection within 7 business days after receipt of Contractor's declaration.

E. Submit a written request for inspection for Substantial Completion. Upon receipt of request, Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion A.I.A. Document G704 or similar, after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

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

F. Upon determining that Work is substantially complete, Architect will:

1. Punch List: Prepare a punch list of items to be completed or corrected, as determined by the inspection.

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

a. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

b. Include the following information at the top of each page:

   1) Project name.
   2) Date.
   3) Name of Architect and Construction Manager.
   4) Name of Contractor.
   5) Page number.

3. Submit list of incomplete items in the following format:

   1) PDF electronic file.

3. Certificate: Prepare and process a certificate of substantial completion, containing:

a. Date of substantial completion.

b. Punchlist of items to be completed or corrected.

c. The time within which punchlist items shall be completed or corrected.

d. Date and time the Owner will take occupancy of Project or designated portion thereof.

e. Responsibilities of Owner and Contractor for:

   1) Insurance.
   2) Utilities.
   3) Operation and maintenance of mechanical, electrical and other systems.
   4) Maintenance and cleaning.
   5) Security.

f. Signatures of:

   1) Architect.
   2) General Contractor.
   3) Owner.
   4) Prime Contractor.

G. Contractor is responsible for the following:

1. Corrections: Complete all Work listed for completion or correction within designated time.

2. Final Cleaning: Perform final cleaning.
H. Occupancy: Using Agency will occupy Project or designated portions thereof under provisions stated in the Certificate of Substantial Completion.

I. Complete All Work: At time of inspection, should substantial completion not be certified, Contractor shall complete the Work and resubmit declaration in accordance with the requirements of this Section.

3.2 CLOSEOUT PROCEDURES:

A. Accompany Project Manager on preliminary inspection to determine items to be listed for completion or correction in Contractor's Notice of Substantial Completion.

B. Accompany Project Manager on preliminary final inspection.

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

D. Notify Architect when work is considered ready for Substantial Completion.

E. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.

F. Owner will occupy all of the building as specified in Section 01010.

G. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.

H. Accompany Project Coordinator on preliminary final inspection.

I. Notify Architect when work is considered finally complete.

J. Complete items of work determined by Architect's final inspection.

3.3 PROJECT RECORD DOCUMENTS:

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

B. Record Prints: Maintain on site one set of marked-up paper copies of the Contract Drawings, Specifications, and Shop Drawings; record actual revisions to the Work:

1. Drawings:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.

2. Specifications.

3. Addenda.

4. Change Orders and other modifications to the Contract.

5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.
7. Inspection Reports.
8. Laboratory Test Records.
10. Factory Test Reports and Records.

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

D. Maintain for record purposes at a location approved by the Architect /Owner, electronic files for those shop drawings and other documents which are required to be submitted electronically. Ensure that backups of electronic files are made on a regular basis and stored at a remote location.

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

F. Record information concurrent with construction progress.

G. Record Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
   2. Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   3. Manufacturer's name and product model and number.
   4. Product substitutions or alternates utilized.

H. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

I. Final Punchlist.

J. Receipt from AHJ regarding substantial completion and certificate of occupancy.

K. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

L. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

3.4 FINAL ACCEPTANCE:

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and complete operations where required.
   2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
3. Submit certified copy of the Architect’s final inspection list of items to be completed or corrected, endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Architect.

4. Submit consent of surety to final payment.

5. Submit evidence of final, continuing insurance coverage complying with insurance requirements.


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

B. Final Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect and Construction Manager will either proceed with inspection with Contractor or/and as appropriate notify Contractor of unfulfilled requirements to ensure completion of all Contract requirements.

C. Closeout Documents: Architect will prepare and process closeout documents when all Work is considered finally complete in accord with Contract Document requirements including all Deliverable Documentation.

D. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

E. Re-inspection Procedure:
   1. The Architect will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Architect.
   2. Upon successful completion of re-inspection, the Architect will prepare a certificate of final acceptance. If the Work is incomplete, the Architect will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance. When necessary, reinspection will be repeated.

END OF SECTION
SECTION 01780
WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Warranties and bonds:

1.2 SUMMARY:

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer’s standard warranties on products and special warranties.
   1. Refer to the General Conditions and Standard Construction Management Agreement for additional terms and requirements affecting the Work.

B. Disclaimers and Limitations: Manufacturer’s disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer’s disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. Manufacturer’s warranties will begin upon Final Acceptance by Owner. Equipment was used, started or operated during construction period. “Acceptance” will be mutually agreed by Owner, Architect, Engineer and Owners Representative.

1.3 RELATED SECTIONS:

A. Section 01300 - Administrative Requirements: Shop drawings, product data, and samples.

B. Section 01330 - Submittal Requirements: Submittals procedures.

C. Section 01770 - Closeout Procedures and Submittals: Contract closeout procedures.

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

E. Individual Product Sections: Warranties required for specific products or Work.

1.4 DEFINITIONS:

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.5 WARRANTY REQUIREMENTS:

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefitted from use of the Work through a portion of its anticipated useful service life.

D. Owner’s Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.6 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect’s Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

C. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

D. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with Owner’s permission, submit documents within 10 days after acceptance, to Project Manager.

2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment, to Project Manager.

3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period, to Project Manager.

E. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
F. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.

2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name, address and telephone number of the Contractor and equipment supplier; and name of responsible company principal.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 LIST OF WARRANTIES:

A. Schedule: Provide warranties on products and installations as specified in individual Sections in Divisions 2 through 16.

3.2 WARRANTIES AND BONDS:

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submission.

E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

G. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Product maintenance manuals.
   5. Systems and equipment maintenance manuals.

1.2 RELATED REQUIREMENTS:

A. Section 01330 - Submittal Procedures: for submitting copies of submittals for operation and maintenance manuals.

B. Section 01810 - General Commissioning Requirements: for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS:

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

C. Format: Submit operations and maintenance manuals in the following format:
      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      b. Enable inserted reviewer comments on draft submittals.

D. Initial Manual Submittal: Submit draft copy of each manual at least [30] days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
E. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least [15] days before commencing demonstration and training. 

Architect and Commissioning Authority will return copy with comments.

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

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY:

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

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

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

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

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

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS:

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

1. Title page.
2. Table of contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.
C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

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

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

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
   1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS:

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   5. Power failure.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

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

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.4 OPERATION MANUALS:

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   2. Performance and design criteria if Contractor has delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

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

C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

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

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

2.5 PRODUCT MAINTENANCE MANUALS:

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

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

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

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

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS:

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and
C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

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

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

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION:

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

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

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

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

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

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

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

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 01770 - Closeout Procedures and Submittals

G. Comply with Section 01770 - Closeout Procedures and Submittals, for schedule for submitting operation and maintenance documentation.

END OF SECTION
SECTION 01810
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. OPR and BoD documentation are included by reference for information only.

1.2 SECTION INCLUDES:

A. General requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

1.3 RELATED SECTIONS:

A. Section 01815 - Commissioning of HVAC: for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.

1.4 DEFINITIONS:

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.5 COMMISSIONING TEAM:

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:
   1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
   2. Representatives of the facility user and operation and maintenance personnel.
   3. Architect and engineering design professionals.

1.6 OWNER'S RESPONSIBILITIES:
A. Provide the OPR documentation to the CxA and each Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.7 EACH CONTRACTOR’S RESPONSIBILITIES:

A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.

3. Attend commissioning team meetings held on a [weekly] [biweekly] [monthly] [variable] basis.

4. Integrate and coordinate commissioning process activities with construction schedule.

5. Review and accept construction checklists provided by the CxA.

6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a [daily] [weekly] basis.

7. Review and accept commissioning process test procedures provided by the Commissioning Authority.

8. Complete commissioning process test procedures.

1.8 CxA’S RESPONSIBILITIES:

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Prepare and maintain the Issues Log.

G. Prepare and maintain completed construction checklist log.

H. Witness systems, assemblies, equipment, and component startup.

I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION
SECTION 01815
COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES:
A. Commissioning process requirements for HVAC&R systems, assemblies, and equipment.

1.2 RELATED SECTIONS:
A. Section 01810 - General Commissioning Requirements: for general commissioning process requirements.
B. Section 15945 - Building Commissioning.

1.3 DEFINITIONS:
A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
B. CxA: Commissioning Authority.
D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean “as-built” systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS:
A. Certificates of readiness.
B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES:
A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the “Schedule of Allowances” Article in Section 01210 - Allowances.

1.6 CONTRACTOR’S RESPONSIBILITIES:
A. Perform commissioning tests at the direction of the CxA.
B. Attend construction phase controls coordination meeting.
C. Attend testing, adjusting, and balancing review and coordination meeting.
D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
E. Provide information requested by the CxA for final commissioning documentation.
F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA’S RESPONSIBILITIES:

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.


1.8 COMMISSIONING DOCUMENTATION:

A. Provide the following information to the CxA for inclusion in the commissioning plan:
   1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
   2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
   3. Process and schedule for completing construction checklists and manufacturer’s prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
   4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
   5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
   6. Test and inspection reports and certificates.
   7. Corrective action documents.
   8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TESTING PREPARATION:

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION:

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least [10] days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
   1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
   2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
   3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
   4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS:

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R [Contractor] [Subcontractor], testing and balancing [Contractor] [Subcontractor], and HVAC&R Instrumentation and Control [Contractor] [Subcontractor] shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.
H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R systems, subsystems, and equipment Testing Procedures:

A. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 15.

B. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
   1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
   2. Description of equipment for flushing operations.
   4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

C. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

D. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hydronic distribution systems.

E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION
SECTION 01820
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Demonstration of products and systems where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required.
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Landscape irrigation.
   6. Items specified in individual product Sections.

C. Training of Owner personnel in care, cleaning, maintenance, and repair is required.
   1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
   2. Finishes, including flooring, wall finishes, ceiling finishes.
   3. Fixtures and fittings.
   4. Items specified in individual product Sections.

D. Administrative and procedural requirements for instructing Owner's personnel, including the
   1.2 RELATED REQUIREMENTS:
   A. Section 01700 - Execution Requirements:
   B. Section 01770 - Closeout Procedures and Submittals
   C. Other Specification Sections: Additional requirements for demonstration and training

1.3 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

C. Qualification Data: For instructor.

D. Attendance Record: For each training module, submit list of participants and length of instruction time.

E. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
Closeout Submittals:
1. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
   a. Identification: On each copy, provide an applied label with the following information:
      1) Name of Project.
      2) Name and address of videographer.
      3) Name of Architect.
      4) Name of Construction Manager.
      5) Name of Contractor.
      6) Date of video recording.
2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format on compact disc.

1.4 QUALITY ASSURANCE:

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

B. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
      a. A factory-authorized service representative, complying with requirements in Section 01400 - Quality Requirements, experienced in operation and maintenance procedures and training.
      b. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

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

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01300 – Administrative Requirements. Review methods and procedures related to demonstration and training including, but not limited to, the following:
   1. Inspect and discuss locations and other facilities required for instruction.
   2. Review and finalize instruction schedule and verify availability of educational materials, instructors’ personnel, audiovisual equipment, and facilities needed to avoid delays.
   3. Review required content of instruction.
   4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION:

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM:

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

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

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

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

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

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

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

PART 3 - EXECUTION

3.1 DEMONSTRATION – GENERAL:
   A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
   B. Demonstration may be combined with Owner personnel training if applicable.
   C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
      1. Perform demonstrations not less than two weeks prior to Substantial Completion.
      2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
   D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
      1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.2 TRAINING – GENERAL:
   A. Conduct training on-site unless otherwise indicated.
   B. Owner will provide classroom and seating at no cost to Contractor.
   C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
3.3 PREPARATION:
A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01782 - Operation and Maintenance Data.
B. Set up instructional equipment at instruction location.

3.4 INSTRUCTION:
A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish an instructor to describe Owner's operational philosophy.
   3. Owner will furnish Contractor with names and positions of participants.
C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Architect with at least seven (7) days' advance notice.
D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.5 DEMONSTRATION AND TRAINING VIDEO RECORDINGS:
A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.
B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
   1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
   2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.
e. E-mail address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
   1. Film training session(s) in segments not to exceed 15 minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
      c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
   1. Furnish additional portable lighting as required.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

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

G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Selective site and building demolition. Protection of existing and removal of indicated items, including, but not limited to:
   1. Removal of temporary partitions, fencing, and protections.
   2. Identification of utilities.
   4. Pay for the legal and environmentally safe off-site disposal or recycling of construction debris.
   5. Removal of asphalt and concrete paving.
   6. Removal of concrete curb work.

B. Related Sections:
   1. Geotechnical Report - Published Separately
   2. Section 02110 - Site Clearing.
   3. Section 02200 - Earthwork.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   1. Conform to applicable federal, state, and local codes for demolition work, safety of structure, dust control, and debris removal.
   2. Obtain required permits from authorities.
   3. ANSI A10.6 - Safety Requirements for Demolition.
   4. Requirements of affected utility companies.
   5. Conform to geotechnical investigation recommendations.

B. Structural Integrity: Maintain structural integrity to existing building at all times.

1.3 SUBMITTALS

A. Schedule: Submit sequence of demolition operations to Owner for review prior to start of work to prevent interruption of Owner’s on-site operations.
   1. Coordinate shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
   2. Coordinate with Owner’s continuing occupation of portions of existing building.

B. Shop Drawings: Indicate location and construction of temporary work.

C. Concrete Cutting: Submit 3 copies of proposed cutting procedures and operations for each type of concrete demolition for review and approval prior to starting the work. Outline types of equipment proposed, protections to be installed, and cutting schedule.

D. Project Record Documentation: Accurately record and submit actual locations of capped utilities, subsurface obstructions, and related details.
1.4 PROJECT CONDITIONS

A. Occupancy: Owner will occupy adjacent portions of the building. Conduct work to minimize disruption of Owner's normal operations. Provide minimum of 72 hours prior written notice to Owner when activities affect Owner's normal operations.

B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

C. Protections: Provide temporary barriers to protect Owner's personnel, the residents, and public from injury from work.
   1. Take required protective measures to provide free and safe passage to occupied portions of building.
   2. Erect temporary covered passageways as required by authorities having jurisdiction.
   3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
   4. Protect existing work, which becomes exposed during demolition operations.
   5. Protect floors with coverings.
   6. Construct temporary insulated dustproof partitions to separate areas from noisy or extensive dirt or dust operations when performed. Equip partitions with dustproof doors and security locks.
   7. Provide temporary weather protection when exposing exterior conditions to prevent water leakage or damage to structure or interior areas of existing building.
   8. Remove protections at completion of work.

D. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

E. Traffic: Conduct operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close, block, or otherwise obstruct streets, walks, or occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around obstructed traffic ways.

F. Explosives: Explosives are not permitted at the site.

G. Flame Cutting: Do not use cutting torches for removal until flammable materials are removed. At concealed spaces, verify conditions prior to flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.

H. Utility Services: Maintain existing utilities and protect against damage during demolition operations.
   1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, acceptable to Owner and governing authorities.

I. Fire Protection: Maintain fire protection services during selective demolition operations.
J. Environmental Controls: Use water sprinkling, temporary enclosures, or other acceptable methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.
   1. Do not use water when it may create hazardous or objectionable conditions.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide shoring, bracing, or support to prevent movement, settlement, or collapse.

B. Cover and protect furniture, equipment, and fixtures from soilage or damage as necessary.

C. Temporary Partitions and Protections: Erect and maintain dust proof partitions and closures to prevent spread of dust or fumes to occupied portions of the building.
   1. Construct dust proof partitions of minimum 4 inch studs, 5/8 inch drywall (joints taped) on occupied side, ½ inch fire retardant plywood on demolition side. Fill partition cavity with sound deadening insulation.
   2. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Locate, identify, stub off, and disconnect utility services indicated to remain.
   1. Provide bypass connections to maintain services to occupied areas.

3.2 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with occupied building areas.

B. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.

C. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.

D. Provide services for effective air and water pollution controls required by local authorities having jurisdiction.

E. Exercise extreme care to salvage those items indicated to be reused. Stockpile and protect in an appropriate location.

3.3 DEMOLITION

A. Perform demolition activities in a systematic manner.

B. Demolish concrete in small sections. Cut concrete at junctures with construction to remain using power driven masonry saw or hand tools; do not use power driven impact tools.
C. Demolish foundation walls to a minimum depth of 12 inches below existing ground surface. Demolish and remove below grade wood or metal construction. Break up below grade concrete slabs.

D. For interior slabs on grade, use removal methods to prevent cracking or structurally disturbing adjacent slabs or partitions. Use power saw where possible.

E. Completely fill below grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter, per soils report.

F. If unanticipated mechanical, electrical, or structural elements conflicting with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner in written, accurate detail. Pending receipt of directive from Owner's Representative, rearrange selective demolition schedule as necessary to continue overall job progress without undue delay.

3.4 REMOVAL OF STRUCTURES

A. Pneumatic Operated Hammers: When possible, reduce use of pneumatic operated hammers. When necessary to use pneumatic tools, locate compressors as remote from occupied areas as possible.
   1. To break large pieces of concrete, isolate concrete from floor slabs and building structure to prevent structure borne vibration.

B. Saw Cutting: Locate compressors as remote as possible from occupied areas of facility.
   1. Use diamond tipped saw blades and related equipment.
   2. Saw cut portions of walls and slabs. Angle saw blade at floors and corners to cut as closely as possible to desired location.
   3. Control runoff water used with saw to prevent damage to existing materials.

C. Retaining and site walls: remove walls and foundation where indicated.

3.6 SALVAGED MATERIALS

A. Coordinate with Architect/Owner items to be recycled.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from site, debris, rubbish, and other materials resulting from operations. Transport and legally dispose off site.
   1. Burning of removed materials is not permitted on project site.
   2. Where possible, make use of recycling services and centers for demolished materials.

3.8 SITE DEMOLITION

A. Remove curbwork, brick pavers, asphalt and concrete paving noted to be demolished.

B. Restore any asphalt paving that has been damaged along sawcut lines, to original condition.
3.9 BUILDING DEMOLITION

A. Remove existing structures noted to be demolished.

B. Restore substrate under demolished items to finish acceptable to Architect/Geotechnical Engineer.

3.10 CLEANUP AND REPAIR

A. Upon completion of work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean.
   1. Repair demolition performed in excess of required at no expense to Owner. Return construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by work.

B. Do not allow rubbish and debris to accumulate. Clean and sweep building areas, roads, streets, drives, parking lots, sidewalks, adjoining properties, and areas affected by demolition operation on a daily basis.

C. Remove temporary protections and barriers.

END OF SECTION
SECTION 02 0 70
SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Selective site and building demolition. Protection of existing and removal of indicated items, including, but not limited to:
   1. Removal of temporary partitions, fencing, and protections.
   2. Identification of utilities.
   4. Pay for the legal and environmentally safe off site disposal or recycling of construction debris.
   5. Removal of asphalt and concrete paving.
   6. Removal of concrete curb work.

1.2 RELATED SECTIONS:

A. Geotechnical Report-Published Separately
B. Section 02110 - Site Clearing.
C. Section 02200 - Earthwork.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   1. Conform to applicable federal, state, and local codes for demolition work, safety of structure, dust control, and debris removal.
   2. Obtain required permits from authorities.
   3. ANSI A10.6 - Safety Requirements for Demolition.
   4. Requirements of affected utility companies.
   5. Conform to geotechnical investigation recommendations.

B. Structural Integrity: Maintain structural integrity to existing building at all times.

1.4 SUBMITTALS

A. Schedule: Submit sequence of demolition operations to Owner for review prior to start of work to prevent interruption of Owner’s on site operations.
   1. Coordinate shutoff, capping, and continuation of utility services as required, together with details for dust and noise control protection.
   2. Coordinate with Owner's continuing occupation of portions of existing building.

B. Shop Drawings: Indicate location and construction of temporary work.

C. Concrete Cutting: Submit 3 copies of proposed cutting procedures and operations for each type of concrete demolition for review and approval prior to starting the work. Outline types of equipment proposed, protections to be installed, and cutting schedule.

D. Project Record Documentation: Accurately record and submit actual locations of capped utilities, subsurface obstructions, and related details.
1.5 PROJECT CONDITIONS

A. Occupancy: Owner will occupy adjacent portions of the building. Conduct work to minimize disruption of Owner's normal operations. Provide minimum of 72 hours prior written notice to Owner when activities affect Owner's normal operations.

B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

C. Protections: Provide temporary barriers to protect Owner's personnel, the residents, and public from injury from work.
   1. Take required protective measures to provide free and safe passage to occupied portions of building.
   2. Erect temporary covered passageways as required by authorities having jurisdiction.
   3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
   4. Protect existing work, which becomes exposed during demolition operations.
   5. Protect floors with coverings.
   6. Construct temporary insulated dustproof partitions to separate areas from noisy or extensive dirt or dust operations when performed. Equip partitions with dustproof doors and security locks.
   7. Provide temporary weather protection when exposing exterior conditions to prevent water leakage or damage to structure or interior areas of existing building.
   8. Remove protections at completion of work.

D. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

E. Traffic: Conduct operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close, block, or otherwise obstruct streets, walks, or occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around obstructed traffic ways.

F. Explosives: Explosives are not permitted at the site.

G. Flame Cutting: Do not use cutting torches for removal until flammable materials are removed. At concealed spaces, verify conditions prior to flame cutting operations. Maintain portable fire suppression devices during flame cutting operations.

H. Utility Services: Maintain existing utilities and protect against damage during demolition operations.
   1. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, acceptable to Owner and governing authorities.

I. Fire Protection: Maintain fire protection services during selective demolition operations.

J. Environmental Controls: Use water sprinkling, temporary enclosures, or other acceptable methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

K. Do not use water when it may create hazardous or objectionable conditions.

PART 2 - PRODUCTS - NOT USED.
PART 3 - EXECUTION

3.1 PREPARATION

A. Provide shoring, bracing, or support to prevent movement, settlement, or collapse.

B. Cover and protect furniture, equipment, and fixtures from soilage or damage as necessary.

C. Temporary Partitions and Protections: Erect and maintain dust proof partitions and closures to prevent spread of dust or fumes to occupied portions of the building.
   1. Construct dust proof partitions of minimum 4 inch studs, 5/8 inch drywall (joints taped) on occupied side, ½ inch fire retardant plywood on demolition side. Fill partition cavity with sound deadening insulation.
   2. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Locate, identify, stub off, and disconnect utility services indicated to remain.
   1. Provide bypass connections to maintain services to occupied areas.

3.2 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with occupied building areas.

B. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.

C. Locate demolition equipment throughout structure and promptly remove debris to avoid imposing excessive loads on supporting walls, floors, or framing.

D. Provide services for effective air and water pollution controls required by local authorities having jurisdiction.

E. Exercise extreme care to salvage those items indicated to be reused. Stockpile and protect in an appropriate location.

3.3 DEMOLITION

A. Perform demolition activities in a systematic manner.

B. Demolish concrete in small sections. Cut concrete at junctures with construction to remain using power driven masonry saw or hand tools; do not use power driven impact tools.

C. Demolish foundation walls to a minimum depth of 12 inches below existing ground surface. Demolish and remove below grade wood or metal construction. Break up below grade concrete slabs.

D. For interior slabs on grade, use removal methods to prevent cracking or structurally disturbing adjacent slabs or partitions. Use power saw where possible.

E. Completely fill below grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel, or sand, free of trash and debris, stones over 6 inches in diameter, roots, or other organic matter, per soils report.

F. If unanticipated mechanical, electrical, or structural elements conflicting with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner in written, accurate detail. Pending receipt of directive from Owner's Representative, rearrange selective demolition schedule as necessary to continue overall job
progress without undue delay.

3.4 REMOVAL OF STRUCTURES

A. Pneumatic Operated Hammers: When possible, reduce use of pneumatic operated hammers. When necessary to use pneumatic tools, locate compressors as remote from occupied areas as possible.
   1. To break large pieces of concrete, isolate concrete from floor slabs and building structure to prevent structure borne vibration.

B. Saw Cutting: Locate compressors as remote as possible from occupied areas of facility.
   1. Use diamond tipped saw blades and related equipment.
   2. Saw cut portions of walls and slabs. Angle saw blade at floors and corners to cut as closely as possible to desired location.
   3. Control runoff water used with saw to prevent damage to existing materials.

C. Retaining and site walls: remove walls and foundation where indicated.

3.5 SALVAGED MATERIALS

A. Coordinate with Architect/Owner items to be recycled.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from site, debris, rubbish, and other materials resulting from operations. Transport and legally dispose off site.
   1. Burning of removed materials is not permitted on project site.
   2. Where possible, make use of recycling services and centers for demolished materials.

3.7 SITE DEMOLITION

A. Remove curbwork, brick pavers, asphalt and concrete paving noted to be demolished.

B. Restore any asphalt paving that has been damaged along sawcut lines, to original condition.

3.8 BUILDING DEMOLITION

A. Remove existing structures noted to be demolished.

B. Restore substrate under demolished items to finish acceptable to Architect/Geotechnical Engineer.

3.9 CLEANUP AND REPAIR

A. Upon completion of work, remove tools, equipment, and demolished materials from site. Remove protections and leave interior areas broom clean.
   1. Repair demolition performed in excess of required at no expense to Owner. Return construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by work.

B. Do not allow rubbish and debris to accumulate. Clean and sweep building areas, roads, streets, drives, parking lots, sidewalks, adjoining properties, and areas affected by demolition operation on a daily basis.

C. Remove temporary protections and barriers.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Site clearing including but not limited to:
   1. Determining site grades.
   2. Topsoil stripping, stockpiling.
   3. Topsoil excavation.
   4. Removal of above and below grade improvements.
   5. Removal of paving and curbs.
   7. Control of site drainage during construction.
   8. Legal removal of rubbish and debris.

B. Related Sections:
   1. Geotechnical Report-Published Separately
   2. Section 02070 - Selective Demolition.
   3. Section 02200 - Earthwork.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements, Standards, and Codes:
   1. Comply with applicable federal, state, and local codes for environmental requirements, disposal of debris, and use of herbicides.
   3. Conform to geotechnical investigation recommendations.

B. Survey Services: Engage the services of a Licensed Surveyor or Registered Engineer, licensed in the state in which the work is being performed, to layout and perform staking for walks, drives, parking lots, building location and grades.

C. Coordinate work with utility companies.

1.3 PROJECT CONDITIONS

A. Traffic: Conduct operations to ensure minimum interference with roads and adjacent occupied facilities. Do not close or obstruct streets, walks, or occupied facilities without permission from authorities having jurisdiction.

B. Protections:
   1. Utilities: Protect existing service lines and related structures to remain. When necessary, arrange for repair with proper utility company.
   2. Report uncharted or incorrectly charted lines to the Architect for further direction.
   3. Improvements: Protect improvements on adjoining properties and on Owner's property. Permission to perform removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
   4. Restore damaged improvements to original condition, as acceptable to property owners.
5. Salvageable Improvements: Carefully remove items indicated to be salvaged and store where directed. Coordinate with Owner.

1.4 LINES AND GRADES

A. The Drawings, in general, indicate proposed final grades. Provide rough grading to below the final grades in accordance with the depths indicated on the Drawings.

PART 2 - PRODUCTS

Not Used

PART 3 - PART EXECUTION

3.1 PREPARATION

A. Identify a waste area and salvage area for placing removed materials. Coordinate with Owner.

3.2 PROTECTIONS

A. Locate, identify, and protect utilities to remain from damage.

B. Protect bench marks, survey control points, and existing structures from damage or displacement.

3.3 CLEARING

A. Clear areas required for access to site and execution of work.

B. Removal of Vegetation: Remove and haul off site trees and shrubs within 36 hours of cutting.
   1. Comply with authorities having jurisdiction for removal, cutting, shredding, and disposal of trees.
   2. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions, except for those indicated to be left standing, to permit installation of new construction. Removal includes digging out and off site disposal of stumps and roots.
   3. Cut minor roots and branches of trees indicated to remain in clean manner when roots and branches obstruct installation of new construction.

C. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.
   1. Completely remove stumps, roots, and other debris protruding through ground surface.
   2. Use hand methods for grubbing inside drip line of trees indicated to remain.
   3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
   4. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

D. Topsoil: Excavate topsoil without mixing with foreign materials. Do not excavate wet topsoil.
   1. Remove heavy growths of grass from areas before stripping.
   2. Where existing trees are indicated to remain, leave topsoil in place within drip lines to prevent damage to root system.
   3. Stockpile topsoil in areas directed. Construct storage piles to provide free drainage of surface water. Cover storage piles to prevent wind erosion.
   4. Legally dispose of unsuitable, uncontrolled fill or excess topsoil from site.
3.4 Dewatering

A. Prevent surface or ground water from flowing into excavations.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and diversions outside excavation limits to prevent water from collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

3.5 Removal

A. Legally remove and dispose of uncontrolled soil material, debris, rock above acceptable size as indicated in soils report, extracted plant life, paving, discarded pieces of concrete and reinforcing steel and curbs from site.

B. Excavate and legally remove underground storage tanks, retaining straps, associated plumbing piping, foundation pad, and contaminated soil.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Earthwork including, but not limited to:
   1. Preparing and grading of subgrade for slabs on grade, walks, pavements.
   2. Excavating and backfilling for buildings and structures.
   3. Drainage and moisture control of fill course, slabs on grade.
   4. Subbase course for walks and pavements.
   5. Subsurface drainage backfill for walls and trenches.
   6. Excavating and backfilling of trenches within building lines.
   7. Excavating and backfilling for underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.
   8. Accessories and related work required.

1.2 RELATED SECTIONS:

A. Geotechnical Report-Published Separately
B. Section 01430 - Quality Control.
C. Section 02070 - Selective Demolition.
D. Section 02110 - Site Clearing.
E. Section 02225 - Trenching.
F. Section 02520 - Portland Cement Concrete Paving.
G. Section 02665 - Water Systems.
H. Section 02730 - Sanitary Sewage.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO).
D. Geotechnical Report.

1.4 DEFINITIONS

A. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.
B. Subgrade: Uppermost surface of excavation or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
C. Borrow: Soil material obtained off site when sufficient approved soil material is not available from excavations.

D. Subbase Course: Layer placed between subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.

E. Base Course: Layer placed between subbase and surface pavement in a paving system.

F. Drainage Fill: Course of washed granular material supporting slab on grade placed to cut off upward capillary flow of pore water.

G. Uncontrolled Fill: Existing fill not properly placed, observed, and tested.

H. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect/Geotechnical Engineer, is the Contractor's expense.

I. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. When acceptable to Architect/Geotechnical Engineer, use lean concrete fill to bring elevations to proper position.
   1. In locations other than above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect/Geotechnical Engineer.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or man made stationary features constructed above or below ground surface.

K. Utilities include on site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

L. Additional Excavation: When excavation has reached required subgrade elevations, notify Architect/Geotechnical Engineer, who will make an inspection of conditions. If Architect/Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Architect/Geotechnical Engineer. The Contract Sum may be adjusted by an appropriate Contract Modification.

M. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements, Codes and Standards:
   1. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Testing and Inspection Service: Contractor shall employ and pay for a qualified independent geotechnical testing laboratory to perform soil testing and inspection service during earthwork operations.
   1. Conform to Geotechnical Investigation Recommendations.

C. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory
must demonstrate to Architect's/Owner's satisfaction, based on evaluation of laboratory submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct required field and laboratory geotechnical testing without delaying the progress of the Work.

1.6 SUBMITTALS

A. Product Data: Manufacturer's technical data for each type of plastic warning tape and filter fabric.

B. Samples: 12" by 12" sample of filter fabric.

C. Test Reports: Submit reports directly to Architect/Owner from the testing services, with copy to Contractor,
   1. Submit test reports as required by authorities having jurisdiction and soils report requirements.

1.7 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner is not responsible for interpretations and conclusions drawn from data by the Contractor.
   1. Additional test borings and exploratory operations may be performed by Contractor at Contractor's option. No change in Contract Sum will be authorized for additional exploration.

B. Existing Utilities: Do not interrupt existing utilities serving adjacent properties except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
   1. Provide minimum 72 hours notice to Architect and receive written notice to proceed before interrupting any utility.
   2. Protect existing service lines and related structures encountered in the excavation work. Where lines and structures have been undermined due to the excavation work, provide suitable supports. If damaged, repair such lines or structures or arrange for their repair with the proper authorities or companies.
   3. Report uncharted or incorrectly charted lines to the Architect for further direction.

C. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

D. Use of Explosives: Use of explosives is not permitted.

E. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights as recommended by authorities having jurisdiction.
   1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

F. Sheet Piling, Bracing, and Shoring: Take precaution to guard against movement and settlement of new construction, utilities, paving, walks, light standards, piping, and conduit. Provide and design required sheet piling, bracing, and shoring adequate to prevent movement and settlement.

PART 2 - PRODUCTS
2.1 SOIL MATERIALS

A. Refer to Soils Report-Published Separately.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid and alkali resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150mm) wide and 4 mils thick minimum, continuously inscribed with description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2’6” deep.
   1. Tape Colors:
      b. Yellow: Gas, oil, steam, and dangerous materials.
      c. Orange: Telephone and other communications.
      d. Blue: Water systems.
      e. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. 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.

D. Topsoil and Fill: Strip topsoil and fill indicated for removal, from the entire developed portion of the site. Stockpile free of admixture of subsoil, stones, clods of earth, plants, roots, sticks, and matter not conducive to plant growth.

E. Remove as indicated, existing on grade and below grade construction encountered. In areas of general grading, remove obstructions encountered to depth of minimum 18 inches below rough grades.

3.2 DEWATERING

A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
   3. Where required for deep excavations and when encountering ground water, use sump pumps and well points to control water.

B. Provide erosion control methods in accordance with requirements of authorities having
jurisdiction and recommendations of geotechnical report.

3.3 EXCAVATION

A. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered. Caliche may be encountered during excavation operations.

B. Follow recommendations in Soils Report for over excavation and all uncontrolled materials including but not limited to gypsum materials. Replace uncontrolled material with blended soil mix in accordance with Soils Engineers recommendation. Recompact blended mix and place in a method approved by Soils Engineer.


D. Contractor is responsible for calculating quantities of uncontrolled material to be excavated and replaced.

3.4 STABILITY OF EXCAVATIONS

A. Comply with local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.5 STORAGE OF EXCAVATED MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind blown dust.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
   2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill.

3.6 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

3.7 EXCAVATION FOR PAVEMENTS

A. Cut surface under pavements to comply with cross sections, elevations, and grades as indicated.

3.8 TRENCH EXCAVATION FOR PIPES AND CONDUIT
A. Comply with applicable requirements of authorities having jurisdiction and soils report recommendations.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300mm) higher than top of pipe or conduit, unless otherwise indicated. Clearance: 12 inches (300mm) each side of pipe or conduit.

C. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

D. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.

3.9 APPROVAL OF SUBGRADE

A. Notify Architect/Geotechnical Engineer when excavations have reached required subgrade.

B. When Architect/Geotechnical Engineer determines unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
   1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect/Geotechnical Engineer.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavations as directed by Architect/Geotechnical Engineer.

3.11 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.12 BACKFILL

A. Backfill excavations promptly, but not before completing the following:
   1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Testing, inspecting, and approval of underground utilities.
   4. Concrete formwork removal.
   5. Removal of trash and debris from excavation.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Utility Trench Backfill: Comply with applicable requirements of authorities having jurisdiction and soils report recommendations.

C. Coordinate backfilling with soils and utilities testing.

D. Subsurface Drainage Backfill: Comply with applicable requirements of authorities having jurisdiction and soils report recommendations.
E. Coordinate backfilling with soils and utilities testing.

F. Take care during fill and backfill operations to avoid damage to walls. Do not over compact causing excessive lateral earth pressures on walls.

3.13 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills as recommended by soils report.

B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, scarify and recompact per geotechnical recommendations.

C. Place fill material in layers to required elevations for each location. Refer to civil drawings and specifications and geotechnical data.

3.14 COMPACTION

A. Moisture Control: Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within plus 2 per cent to plus 4 per cent over optimum for fine grained materials and near optimum moisture content for granular. Refer to soils report recommendations.
   1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace or scarify and air dry satisfactory soil material too wet to compact to specified density.
   3. Stockpile or spread and dry removed wet satisfactory soil material.

B. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills per soils report.
   1. When existing ground surface has a density less than that specified for particular area classification, break up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum density.

C. Stabilization: Refer to soils report recommendations.

D. Place backfill and fill materials in accordance to soils report recommendations.

E. Control soil and fill compaction, providing minimum percentage of density specified in Soils Report.

3.15 GRADING

A. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.
   1. Provide a smooth transition between existing adjacent grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding.

C. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.
3.16 FIELD QUALITY CONTROL

A. Provide testing services during construction as required by the jurisdiction having authority. Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.

1. Perform field in place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.

2. Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D 3017.

3. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.

4. Footing Subgrade: For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Architect.

5. Paved Areas and Building Slab Subgrade: Perform at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case fewer than three tests. In each compacted fill layer, perform one field density test for every 2,000 sq. ft. of overlying building slab or paved area, but in no case fewer than three tests.

6. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.

7. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in place density test for each 150 feet or less of trench, but no fewer than two tests.

B. When testing agency report subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

3.17 PROTECTION

A. Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth directed by the Architect; reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

2. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose off Owner's property.
   1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose off Owner's property.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of rock and caliche during excavation.

B. Removal of rock and caliche shall be included in base bid.

1.2 RELATED SECTIONS

A. Section 02200 – Earthwork.

B. Section 02223 – Backfilling.

C. Section 02225 – Trenching.

1.3 REGULATORY REQUIREMENTS

A. Conform to applicable ordinances for mechanical disintegration of rock and caliche.

B. Comply with Uniform Standard Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rock: Solid mineral material with volume in excess of 1/3 cu yd or solid material that cannot be removed with a 3/4 cu yd capacity power shovel or by bulldozer blade or ripper teeth.

B. Caliche: Material commonly understood locally as "caliche and/or cemented sand and gravel" meeting the same criteria as above for "rock".

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify site conditions and note irregularities affecting work of this Section.

B. Coordinate start of work with Owner’s soils engineer.

C. Schedule work to minimize disruption of access to and activities within the existing facilities.

3.2 ROCK REMOVAL

A. Excavate for and remove rock by the mechanical method.

B. Cut away rock to approved depth below bottom of footings per Soils Engineer.

C. Remove layers to provide sound and unshattered base for footings and foundations.
D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

E. Remove excavated material from site unless approved for re-use by the Soils Engineer.

F. Correct unauthorized rock removal in accordance with directions of Soils Engineer.

G. Conduct operations with minimum interference with adjacent structures and occupancies.

H. Conduct operations with minimum interference to public or private accesses. Maintain egress and access at all times.

3.3 FIELD QUALITY CONTROL

A. Provide for visual inspection of bearing surfaces and cavities formed by removed rock under provisions of Sections 01400.

END OF SECTION
SECTION 02221
SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. The extent of selective demolition/removal work required is shown by notes and graphic information on the drawings, and may be summarized, but not by way of limitation, as the removal of existing assemblies from the building interior, the removal of existing mechanical and electrical systems (to the extent indicated), the removal of existing construction (to the extent indicated) from the building and removal work at existing adjacent construction, as necessary to receive or provide for new construction.

1. Note that while the Drawings show the intent of the scope of demolition work, the Contractor shall review the scope and identify to himself or herself the full extent of the demolition work and associated work to be included in the scope to fully execute the design and contract documents.

B. Salvage of Owner-designated materials and equipment.

1.2 RELATED REQUIREMENTS:

A. Section 01045 - Cutting and Patching.
B. Section 02070 - Site Demolition.
C. Section 02110 - Site Clearing.

1.3 REGULATORY REQUIREMENTS:

A. Conform to local codes and ordinances for demolition of construction, safety of adjacent structures, dust control, runoff control and disposal.
B. Obtain required permits from authorities.
C. Notify affected utility companies before starting work and comply with their requirements.
D. Do not obstruct roadways, sidewalks, hydrants without permits from governing agencies and with written approval from the Owner.
E. If hazardous or contaminated materials are encountered, comply with the requirements of the Special Conditions.

1.4 SCHEDULING:

A. Schedule demolition work to coincide with new construction.
B. Schedule work to minimize disruption of access to and activities within the existing facilities.
C. Provide work plan to indicate proposed methods to complete demolition requirements in accordance with proposed schedule.
D. Demolition schedule and work plan shall be approved by Owner prior to start of any demolition work.
E. Do not disable or disrupt building security, fire or life safety systems without 3 days prior written notice to Owner.

1.5 PREDEMOLITION MEETINGS:
A. Pre-demolition Conference: Conduct conference at Project site.
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.
   6. Coordinate Owner requirements for ongoing building operations.
   7. Schedule and mark items for demolition.

1.6 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Submit schedule and work plan for demolition operations to Owner for approval prior to any Work of this section.
C. Indicate proposed methods and sequence of operations. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.
D. Indicate site access routes to and from project site for equipment access and removal of materials for off-site disposal.
E. Include method of covering or enclosing demolition debris to protect existing construction and finishes.

1.7 QUALITY ASSURANCE:
A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 10 years of documented experience.
B. Permits and Licenses: Contractor shall obtain all necessary permits and licenses for performing the Work and shall furnish a copy of same to the County prior to commencing the Work. The Contractor shall comply with the requirements of the permits
C. Notices: Contractor shall issue written notices of planned demolition to companies or local authorities owning utility conduit, wires, or pipes running to or through the project site. Copies of said notices shall be submitted to the County.
D. Utility Services: Contractor shall notify utility companies or local authorities furnishing gas, water, electrical, telephone, or sewer service to remove any equipment in the structures to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.
E. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
F. The Contractor shall comply with the requirements of applicable Federal and State regulations regarding the demolition of structures including ANSI/ NFPA 251 - Building Construction and Demolition Operations and ANSI 10.2 Safety Code, ANSI 10.6 Safety Requirements for Demolition.

1.8 PROJECT CONDITIONS:

A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

B. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities and injury to persons.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
   2. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and Architect.
   3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or other work to remain.
   4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
   5. Protect floors with suitable coverings when necessary.

C. Damages: Promptly repair damages caused to adjacent tenant spaces by demolition work as directed by the Architect at no cost to Owner.

D. Owner assumes no responsibility for condition of areas to be selectively demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

F. Hazardous Materials:
   1. Asbestos Containing Materials (ACM):
      a. It is not expected that asbestos hazardous materials will be encountered in the Work. If constructions suspected of containing Asbestos Containing Materials (ACM) are encountered, do not disturb; immediately notify Architect and Owner. ACM materials will be removed by Owner under a separate contract.
   2. Lead Containing Paint:
      a. It is not expected that lead containing paint is present. If constructions suspected of containing lead containing paint are encountered, do not disturb; immediately notify Architect and Owner. ACM materials will be removed by Owner under a separate contract.
   3. Other Hazardous Materials:
      a. The existing fire exit signs, fire alarm lights, emergency lights, fluorescent lights, may have the potential to contain hazardous materials such as Polychlorinated Biphenyls (PCBs), Mercury (halide) filaments, batteries and/or radioactive material (tritium).
      b. The Contractor is responsible for removing, transporting, and legal disposal in a landfill designated for these hazardous materials.
PART 2 - PRODUCTS - NOT USED.

2.1 MATERIALS:

A. Carefully remove salvageable items such as light fixtures, grilles, doors, hardware, plumbing fixtures, and other items which are not specifically indicated for reuse, but which may have salvage value to the Owner.
   1. Demolished materials and equipment shall be stockpiled in an area designated by the Owner, in a manner that the Owner may determine those items which have salvage value to the Owner.
   2. Those materials, which are not salvaged by the Owner, shall become the possession of the Contractor and shall be immediately removed from the site.

B. Carefully remove materials (in whole or in part as required) that are scheduled for reuse. Store and protect for reinstallation the materials identified by the owner.

PART 3 - EXECUTION

3.1 SCOPE:

A. Remove other items indicated, for salvage, relocation, recycling, and re-use as shown in the Drawings.
   1. Refer to Mechanical and Plumbing Drawings for demolishing, cutting, patching, or relocating plumbing and mechanical items.
   2. Refer to Electrical Drawings for demolishing, cutting, patching, or relocating electrical items.

3.2 EXAMINATION:

A. Existing Facilities: Protect existing facilities and structures designated to remain, temporarily or permanently, from damage during demolition or construction activities. Repair items damaged during demolition or construction activities to their original condition, or replace with new. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition and/or removal work. Repairs, reinforcement or structural replacement shall be approved by Architect or Owner's Representative.

B. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

3.3 PREPARATION:

A. Notify affected utility companies before starting work and comply with their requirements.
   1. Mark location of utilities.
   2. Identify, disconnect, remove and cap designated utilities within demolition areas.

B. Provide, erect, and maintain temporary barriers and security devices where required and as indicated on drawings.

C. Protect existing landscaping materials, appurtenances, and structures which are not to be demolished.

D. Protect benchmarks and existing work from damage or displacement.

E. Prevent movement or settlement of adjacent structures.
F. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

G. Protection of existing building exterior:
   1. Erect weatherproof closures for exterior openings. Maintain exit requirements.
   2. Protect from weather openings cut in existing roof for new work, or where existing roofing is removed to allow new construction to join existing.
   3. Install temporary deck of exterior grade plywood and wood skids, or other material approved by Architect, for material and personnel traffic over existing roofing, to protect existing roof and surrounding surfaces from damage. Repair damage caused to the roof and other items.

H. Dustproof Partitions:
   1. Erect and maintain as required to prevent spread of dust, fumes and smoke to other parts of the building.
   2. On completion, remove partitions and repair damage surfaces to match adjacent surfaces.

I. Roofing Removal: During the removal of the existing parapets and roofing, provide proper protection from falling objects. Maintain interior of building rain and water protection.

3.4 GENERAL PROCEDURES AND PROJECT CONDITIONS:

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain fire watch and portable fire suppression devices during flame cutting operations.
      a. Maintain adequate ventilation when using cutting torches.
      b. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
      c. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
   5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of offsite.
   6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   8. Dispose of demolished items and materials promptly.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
2. Comply with applicable requirements of NFPA 241.
3. Use of explosives is not permitted.
4. 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.
5. Provide, erect, and maintain temporary barriers and security devices.
6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
8. Do not close or obstruct roadways or sidewalks without permit.
9. 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.
10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

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

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

E. Protect existing structures and other elements that are not to be 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.

F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.5 EXISTING UTILITIES:

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.6 SELECTIVE DEMOLITION FOR ALTERATIONS:

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   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. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
   2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
   1. Remove existing roof membrane, flashings, copings, and roof accessories.
   2. Remove existing roofing system down to substrate.

E. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.

F. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Security): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; 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.

G. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
      a. Piping to Be Removed: Remove portion of piping indicated to be removed and
cap or plug remaining piping with same or compatible piping material.

b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

H. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

I. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.7 PATCHING AND REPAIRS:

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching and Repairs: Comply with Section 01045 - Cutting and Patching.
   1. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
   2. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

D. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

E. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.8 DEBRIS AND WASTE REMOVAL:

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

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

C. Remove from site all materials not to be reused on site; do not burn or bury.
D. Leave site in clean condition, ready for subsequent work.

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

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Excavating for placement of replacement paving, curb, gutters or other features.

1.2 RELATED DOCUMENTS


1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Excavating Materials: Lump sum for all work. Includes removal of existing defective pavement, curbs, gutters and other surface features proposed for demolition. Also includes general excavating to required elevations, loading and placing spoils materials in stockpile and removing from site. Over-Excavating: Payment will not be made for over-excavated work not for replacement materials.

1.4 FIELD MEASUREMENTS

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours and datum locations.

B. Locate, identify and protect from damage existing utility lines including but not limited to water, sewer, gas, storm drain, irrigation, electrical lines and other utilities that are proposed to remain.

C. Notify utility company to remove or relocate utilities, if required.

D. Protect plant life, lawns, adjacent private and public property from damage during excavation. Protect bench marks, survey control points, existing structures, walkway overhang support posts, chain link fences, gates and walls, as well as sidewalks, paving and curbs, (proposed to remain), from damage by excavating equipment and vehicular traffic.

3.2 EXCAVATING

A. Saw cut paved areas to be removed in neat straight lines at right angles. Remove defective pavement proposed to be demolished and excavate existing subgrade to accommodate new sub-base, new paving or other site features.

B. When necessary, grade top perimeter of excavating to prevent surface water from draining into excavation.
C. Hand trim excavations, if necessary, to remove loose soil and other material.

D. Notify Owner of unexpected subsurface conditions and discontinue affected Work in area until notified to resume Work.

E. Any areas that are over-excavated shall be repaired by replacing the over-excavated materials with Type II Aggregate Base as specified in Subsection 704.03.04 of the Standard Specifications, then compacting the area to 95% of maximum density. Notify Owner of any over-excavated areas prior to commencing repairs.

F. Stockpile excavated material in area designated on-site, remove excess or unsuitable materials from site daily.

3.3 FIELD QUALITY CONTROL

A. Notify Owner for visual inspection of subgrade bearing surfaces prior to placement of new pavement.

3.4 PROTECTION

A. Protect against displacement of surrounding areas and loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations from freezing, excess water or excess drying.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trench Backfilling
B. Site filling and backfilling.
C. Fill and base under slabs-on-grade and sidewalks,
D. Consolidation and compaction.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Type A - Base: Uniform Standard Specifications for Public Works Construction off-site Improvements, Clark County Area, Nevada, Subsection 704.03.04 - Type II Aggregate Base.

B. Type B - Structural Backfill: Structural Backfill is defined as compacted fill placed for the support of footings, slabs-on-grade, exterior concrete flatwork, retaining walls and pavements. Structural Backfill, both on-site and imported, shall conform to the following requirements:
1. Free of organic material and miscellaneous debris.
2. Contain no material larger than 4 inch nominal size.
3. Non-expansive
4. Liquid limit less than 35
5. Plasticity index less than 15
6. Less than 0.5 percent soluble sodium sulfate salts.
7. Less than 2 percent solubility.
8. Less than 40 percent passing the No. 200 sieve.
9. Approved by Soils Engineer.

C. Type C - Site Backfill: All compacted fill not classified as Structural Backfill. Site Backfill may be excavated on-site soils or imported soils meeting the soils requirements of Structural Backfill.

PART 3 - EXECUTION

3.1 USE OF ON-SITE SOILS AS FILL

A. Existing, on-site, natural soils may be used as fill subject to the approval of the soils engineer.
B. Critical soluble, surficial salt-laden soils excavated from the site shall not be re-used.

3.2 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen, uncontaminated, approved materials.
B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
C. Fill: Place and compact materials in continuous layers not exceeding 8 inches loose thickness.

D. Employ a placement method that does not disturb or damage foundation dampproofing, foundation waterproofing and protective cover, or utilities in trenches.

E. Maintain optimum moisture content of backfill materials to attain required compaction density.

F. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

G. Slope grade away from building minimum 1 inch in 10 ft, unless noted otherwise.

H. Make grade changes gradual. Blend slope into level areas.

I. Remove surplus backfill materials from site.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating trenches for utilities from 5 feet (1.5m) outside building to municipal utilities.
   2. Compacted fill from top of utility bedding to subgrade elevations.
   3. Backfilling and compaction.

1.2 RELATED SECTIONS:

A. Geotechnical Report-Published Separately
B. Section 01430 - Quality Control and Testing Laboratory Services.
C. Section 02200 - Earthwork.
D. Section 02520 Portland Cement Concrete Paving.
E. Section 02665 - Water Systems.
F. Section 02720 - Storm Drainage.
G. Section 02730 - Sanitary Sewage.
H. Division 15 - Mechanical Work.
I. Division 16 - Electrical Work.

1.3 REFERENCES

A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.
C. ASTM D698 - Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
D. ASTM D1556 - Test Method for Density of Soil in Place by the Sand Cone Method.
E. ASTM D1557 - Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
F. ASTM D2167 - Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
G. ASTM D2922 - Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
H. STM D3017 - Test Methods for Moisture Content of Soil and Soil Aggregate Mixtures.
I. Geotechnical Report-Published Separately


1.4 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.5 QUALITY ASSURANCE

A. Verify survey bench mark, control point, and intended elevations for work are as shown on drawings.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
   1. Provide minimum 72 hours notice to Architect and receive written notice to proceed before interrupting any utility.
   2. Protect existing service lines and related structures encountered in the excavation work. Where lines and structures have been undermined due to the excavation work, provide suitable supports. If damaged, repair such lines or structures or arrange for their repair with the proper authorities or companies.
   3. Report uncharted or incorrectly charted lines to the Architect for further direction.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

C. Use of Explosives: Use of explosives is not permitted.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights as recommended by authorities having jurisdiction.
   1. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

E. Sheet Piling, Bracing, and Shoring: Prevent movement and settlement of existing and new construction, utilities, paving, walks, light standards, piping, and conduit. Provide and design sheet piling, bracing, and shoring adequate to prevent movement and settlement.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Backfill and Fill Materials: Geotechnical Report- Published Separately

B. Structural Fill Type: Geotechnical Report- Published Separately

C. Fill Type: Geotechnical Report- Published Separately
D. Concrete: Refer to Section 02520 - Portland Cement Concrete Paving.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect plant life, lawns, rock outcropping, and other features remaining as a portion of final landscaping.

C. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

D. Maintain and protect above and below grade utilities which are to remain.

E. Cut out soft areas of subgrade not capable of compaction in place. Backfill and compact to density equal to or greater than requirements for subsequent backfill material.

3.2 EXCAVATING

A. Excavate subsoil required for utilities.

B. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials interfering with work.

C. Do not interfere with 45 degree bearing splay of foundations.


E. Remove lumped subsoil, boulders, and rock.

F. Correct areas over excavated in accordance with Section 02200.

G. Stockpile excavated material in area designated on site and remove excess material not being used.

H. Remove excavated material from site.

3.3 BACKFILLING

A. Backfill trenches to contours and elevations with approved fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Employ placement method which does not disturb or damage foundation perimeter drainage or utilities in trench.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Remove surplus fill materials from site.

F. Leave fill material stockpile areas completely free of excess fill materials.
3.4 FIELD QUALITY CONTROL

A. Refer to Section 02200 - Earthwork

3.5 PROTECTION OF FINISHED WORK

A. Reshape and recompact fills subjected to vehicular traffic during construction.

B. Settling: Where settling occurs during correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.
   2. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION
SECTION 02 5 10
ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Asphaltic concrete paving.
B. Prime and tack coating.

1.2 SUBMITTALS

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
      a. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
      b. Job-Mix Designs: For each job mix proposed for the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Cement: Subject to compliance with requirements of authorities having jurisdiction.
B. Aggregate for Bituminous Base and Surface Course Mix:
   1. Clean and free of organic matter and of such a nature that it can be compacted to a dense and firm layer capable of supporting loaded trucks and self-propelled pavers without rutting.
   2. Deliver aggregate to site in thoroughly blended condition and handle in a manner to prevent excessive segregation. Do not mix underlying soil or subbase with aggregate base material.

PART 3 - EXECUTION

3.1 ACCESSORIES

A. Prime Coat: Subject to compliance with requirements of authorities having jurisdiction.
B. Tack Coat: Subject to compliance with requirements of authorities having jurisdiction.

3.2 ASPHALT PAVING MIX

A. Subject to compliance with requirements of authorities having jurisdiction.
B. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with Asphalt Institute Manual MS-4 and approved job mix.

3.3 SUBBASE
A. In accordance with Section 02223 - Backfilling.

3.4 PREPARATION - PRIMER

A. Apply primer on base or subbase over subgrade surface and concrete surfaces joined by asphaltic paving, such as concrete curbs and existing paving at cut edges at uniform rate of 0.35 gal/sq. yd.

B. Prime coat to penetrate into aggregate base and be free of puddles before paving operations begin.

3.5 PREPARATION - TACK COAT

A. Apply tack coat on asphalt or concrete surfaces at uniform rate of 1/4 gal/sq. yd.

B. Also apply to contact surfaces of curbs, gutter, walls, sidewalks, lower asphalt lifts or other similar surfaces.

C. Coat surfaces of manhole and catch basin lids, frames, etc. with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.6 PLACING ASPHALT PAVEMENT

A. Place and compact A.C. Pavement to achieve an overall compacted thickness as indicated on the civil improvement plans.

B. Install gutter drainage grilles and frames and manholes in correct position and elevation.

C. Compact pavement by rolling to requirements of Uniform Standard Specifications 401.03.12. Do not displace or extrude pavement form position. Hand compact in areas inaccessible to rolling equipment.

D. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

END OF SECTION
SECTION 02 5 20
PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Construction of walkways.
   2. Related accessories required for complete installation.

1.2 RELATED SECTIONS:

B. Section 02110 – Sitework.
C. Section 02200 – Earthwork.

1.3 REFERENCES

A. American Concrete Institute (ACI).
C. American Disabilities Act Accessibility Guidelines (ADAAG) for Buildings and Facilities.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   2. Local governing regulations having jurisdiction over work.
   3. American Concrete Institute, ACI 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
   4. American Concrete Institute, ACI 305 Hot Weather Concreting.
   5. American Concrete Institute, ACI 306 Cold Weather Concreting.

B. Disability Requirements: Comply with applicable requirements for the American Disabilities Act Accessibility Guidelines (ADAAG) for Buildings and Facilities, including updates and revisions.

C. Testing Laboratory: Employ an independent testing laboratory, acceptable to the Owner, to perform tests and submit reports.
   1. Responsibility: To conduct and interpret tests; submit written reports stating compliance of test specimens to requirements specifically noting deviations.

1.5 SUBMITTALS

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Shop Drawings: Layout showing sidewalks with expansion and control joints.

C. Mix Design: ACI 301; concrete mix designs, including report on designs strength tests.
   1. Submit written report for each proposed concrete mix minimum 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and are acceptable to Architect.
   2. Adjust mix designs when materials characteristics, project conditions, weather, test results, or other circumstances warrant. Do not use concrete mixes until submitted to and reviewed by Architect.

D. Test Reports: Submit 2 copies of test or evaluation reports for concrete materials and mix designs.
   1. Tests of materials, or review of test reports available from suppliers.
   2. Tests of field specimens.

E. Manufacturer's Field Reports: Submit dated delivery tickets.

F. Material Certifications required for concrete, joint fillers, reinforcement, admixtures, hardeners, curing materials, and accessories.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Utilize flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
   1. Use flexible spring steel forms or laminated boards to form radius bends as required.
   2. Coat forms with nonstaining form release agent that do not discolor or deface surface of concrete.


C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60.

D. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends

E. Metal Expansion Cap: Provide 1 for end of each dowel bar in expansion joints. Design caps with one end closed and minimum length of 3 inches to allow bars movement of minimum 1 inch.

F. Hook Bolts: ASTM A 307, Grade A bolts, internally and externally threaded. Design hook bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

G. Concrete Materials:
   1. Portland Cement, ASTM C150-Type V.
H. Normal Weight Aggregates: Clean, coarse aggregate and gravel, free from foreign matter, conforming to ASTM C33.
   2. Do not use fine or coarse aggregates that contain substances causing spalling.

I. Moisture Barrier: ASTM E 154, minimum 8 mil polyethylene sheet.

J. Expansion Joint Materials:
   2. Backer Rod: Provide Cera-Rod Red Rod, heat resistant backer rod for hot and cold applied sealers by W.R. Meadows.


L. Liquid Curing Compound: ASTM C 309, Type I, Class A unless other type acceptable to Architect.

M. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type. Subject to compliance with requirements.

N. Admixtures: Do not use admixtures, other than air entrainment, without prior written approval by Architect.

2.2 CONCRETE MIX, DESIGN, AND TESTING

A. Comply with applicable requirements of ACI 301 and ACI 304 for concrete mix design, sampling and testing, and quality control and as specified.

B. Delivery Tickets: Provide copies of each delivery tickets for concrete delivered to the job site with time and date of departure from plant and time and date of pouring at site stamped on ticket. If water is added to concrete at time of delivery, indicate amount added on delivery ticket. Signature of person authorizing addition of water is required on delivery ticket.

C. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water reducing, air entraining mixture and water to produce the following properties:
   1. Compressive Strength: 4,000 psi, minimum at 28 days in accordance with Standard Method of Making and Curing Concrete Test Specimens in the Laboratory, ASTM C 192 and Standard Method of Test for Compressive Strength of Molded Concrete Cylinder, ASTM C 39.
   2. Slump Limits: Maximum 4 inches.
   3. Air Entrained: 5 to 7 percent by volume.

D. Ready Mixed Concrete: ASTM C 94.

E. Mix concrete until materials are uniformly distributed. Discharge completely before recharging mixer. Proportion aggregate to produce a mixture which readily works into corners and angles of forms and around reinforcement with specified method of placing without segregation of materials or accumulation of excess free water on the surface.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.
B. Proof roll prepared subbase surface checking for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.2 FORM CONSTRUCTION

A. Set forms to require grades and lines, braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Verify completed formwork for grade and alignment to following tolerances:
   1. Top of forms not more than 1/8 inch in 10 feet.
   2. Vertical face on longitudinal axis, not more than 1/4 inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

D. Step Treads: Slope step treads at 1/4 inch per foot to drain.

E. Sidewalks: Secure in place using stakes or braces, with the top edges true to line and grade. Set forms so slabs have a maximum 2% cross slope and maximum 5% longitudinal slope.

3.3 REINFORCEMENT

A. Place reinforcement as specified in Civil Improvement plans.

3.4 CONCRETE PLACEMENT

A. Comply with requirements of ACI 301 and ACI 304 for mixing and placing concrete and as specified.

B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required for uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until required finish elevation and alignment is reached.

C. Place concrete by methods to prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use square faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

D. Lay moisture barrier over compacted leveling course in as long lengths as possible and lap 5 inches minimum. Place top lap on direction of concrete placement. Lay moisture barrier immediately before placing concrete to avoid tearing and puncturing the moisture barrier. Replace damaged sheets before placing concrete.

E. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

F. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than ½ hour, place a construction joint.

3.5 JOINTS

A. Construct expansion, weakened plane (contraction), and construction joints true to line with face
perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline.

B. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

C. Contraction Joints: Provide weakened plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened plane joints for a depth equal to at least 1/4 concrete thickness, as follows:
1. Tooled Joints: Form weakened plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
2. Sawed Joints: Form weakened plane joints with powered saws equipped with shatterproof abrasive or diamond rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or damaged by cutting action.
3. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.
4. Construct contraction joints in slabs-on-ground. Saw cut 1/8" x 1/4" of the slab depth, unless otherwise indicated. Weakened joints shall be 10’ and Isolation Joints every 30’.
5. Construct isolation joints at points of contact between flatwork and vertical surfaces, such as, foundation walls, at existing abutting slabs and elsewhere, as indicated on drawings.

D. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for more than ½ hour, except where such placements terminate at expansion joints.
1. Construct joints using standard metal keyway section forms.
2. Where load transfer slip dowel devices are used, install so one end of each dowel bar is free to move.

E. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, structures, walks, and other fixed objects.
1. Extend joint fillers full width and depth of joint, not less than ½ inch or more than 1 inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
2. Furnish joint fillers in one piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
3. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

F. Sidewalks: Divide surface with grooves extending 1/4 depth of walks plus 1/4 inch minimum, minimum 1/8 inch and maximum 1/4 inch width edged with an edging tool having 1/4 inch radius. Follow joint pattern indicated. Where no joint pattern is indicated request direction in writing from Civil.
1. Expansion Joints: Install preformed ½ inch joint fillers. Set top of joint filler 1 inch below surface for joints receiving sealant. Where the walks are constructed adjacent to pavements or curbs having expansion joints, place expansion joints in walks opposite existing expansion joints as near as practicable. Place expansion joints where walks abut existing walks or curbs, between walks and structures extending through walks, and at locations where thicker expansion joint is not specifically required.
   a. Provide contraction joints where required to ensure that undesirable thermal and shrinkage cracking of slabs are minimized.
   b. Time work so fresh concrete does not ravel and random cracking does not occur.
   c. Clean, prime joints, and fill with sealing compound.

3.6 CONCRETE FINISHING
A. After striking off and consolidating concrete, smooth surface by screening and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10 ft. straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to ½ inch radius. Eliminate tool marks on concrete surface.

D. Sidewalks: Provide thickness required, but not less than 5 inches thick. Install reinforcement 2 inches below top of concrete. Place concrete in successive batches for the entire width of slab, struck off from ½ to 3/4 inches higher than finished slab, tamped until voids are removed and free mortar appears on the surface. Thoroughly spade along edges, strike off to true grade, and finish to true and even surface with floats and trowels.

E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.

F. Finishing: After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface.

1. Sidewalks: Perform final troweling steel trowel, leaving a smooth, even surface. After water sheen has disappeared, begin final finish of light brooming. Draw broom across walks at right angles to edges of walk, with adjacent strokes slightly overlapping, to produce uniform, slightly roughened surface with paralleled broom marks.

3.7 CURING

A. Protect freshly deposited concrete from premature drying and maintain without drying at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete. Use membrane forming curing and sealing compound or approved moist curing methods.

3.8 CONCRETE SEALING

A. Do not apply until resin base curing compound has minimum 30 days to dissipate and in accordance with manufacturer's recommendations.

B. Test for pH level, according to repellent manufacturer's instructions to ensure chemical bond to silicates minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass where possibility of water repellent being deposited on surfaces exists. Cover live plants and grass. Immediately clean water repellent from adjoining surfaces, complying with manufacturer’s cleaning recommendations.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.

1. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. Apply heavy saturation spray coating of water repellent on surfaces indicated for treatment using low pressure spray equipment. Comply with manufacturer's instructions and
recommendations using airless spraying procedure.

3.9 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, as directed by Owner at no additional expense to Owner.

B. Drill test cores where directed by Civil/Owner 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 until acceptance of work. Exclude traffic from pavement for minimum 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. Sweep concrete walks and wash free of stains, discolorations, dirt, and foreign material before final inspection.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Tying into existing water distribution systems including but not limited to:
   1. Water systems piping for potable water service and fire protection services.
   2. Cleaning and disinfecting water piping system.
   3. Accessories required for a complete installation.

1.2 RELATED SECTIONS:

A. Geotechnical Report-Published Separately
B. Section 02225 - Trenching.
C. Division 15 - Mechanical Work.

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME).
C. American Water Works Association (AWWA).
D. Underwriter's Laboratories (UL) 246 Hydrants for Fire Protection Service.
E. Geotechnical Report- Published Separately

1.4 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   1. Comply with applicable section of the Uniform Building Code, 1997 UBC.
   3. Comply with requirements of utility supplying water, including tapping of water mains and backflow prevention.
   4. Comply with standards of authorities having jurisdiction for fire protection systems, including materials, hose threads, installation, and testing.
   5. Comply with standards of authorities having jurisdiction for potable water piping and plumbing systems, including materials, installation, testing, and disinfection.
   6. National Fire Protection Association:
   7. Approval Stamps:
      a. Listing/approval stamp, label, or other marking on equipment made to specified
b. Listing and Labeling: Provide equipment and accessories listed and labeled as defined in National Electrical Code, Article 100.

8. Disinfection of System: Perform work in accordance with AWWA C651.

B. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

C. Water Treatment Firm: Firm specializing in disinfecting potable water systems having minimum 5 years documented experience.

D. Testing Firm: Firm specializing in testing and examining potable water systems, certified by the State of Nevada.

E. Submit bacteriologist's signature and authority associated with testing.

1.5 SUBMITTALS

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements

B. Product Data:
   1. Technical data including pressure rating, rated capacity, and settings of selected models for the following:
      2. Backflow preventers.
      3. Valves.
      4. Identification materials and devices.
      5. Technical data for disinfecting chemicals.

C. Record Drawings: At project closeout of installed water system piping and products.

D. Reports and Certifications:
   1. Test Reports: Indicate results comparative to specified requirements including pressure and distribution testing.
   2. Certification: Certified test results from testing laboratory.
   3. Certification: Cleanliness of water distribution system meets or exceeds specified requirements and as required by local codes.
   4. Disinfection Report:
      5. Type and form of disinfectant used.
      6. Date and time of disinfectant injection start and time of completion.
      7. Test locations.
      8. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
      9. Date and time of flushing start and completion.
     10. Disinfectant residual after flushing in ppm for each outlet tested.
     11. Bacteriological report:
          12. Date issued, project name, and testing laboratory name, address, and telephone number.
          13. Time and date of water sample collection.
          14. Name of person collecting samples.
          15. Test locations.
          16. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
          17. Coliform bacteria test results for each outlet tested.
          18. Certification that water conforms, or fails to conform, to bacterial standards of State of Nevada.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Preparation for Transport:
   1. Ensure valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends, flange faces, and weld ends.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. Storage:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect valves from weather. Store valves indoors and maintain temperature higher than ambient dew point temperature. Support valves off ground or pavement in watertight enclosures when outdoor storage is necessary.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility locating service for area where Project is located.

B. Verify water system piping may be installed in compliance with original design and referenced standards.

C. Site Information: Reports on subsurface condition investigations made during the design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Owner assumes no responsibility for interpretations or conclusions drawn from this information. Refer to Document 00220.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate connection to water main with UNLV Maintenance.

B. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building fire protection systems piping.

C. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building water distribution systems piping.

D. Coordinate with other utility work.

E. Coordinate electrical requirements of actual equipment furnished with requirements specified in Division 16.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Subject to compliance with requirements of authorities having jurisdiction, provide products by one of the following:

   1. Gate Valves:
      b. Clow Valve Co. Div., McWane, Inc.
      c. Kennedy Valve Div., McWane, Inc.
      d. Mueller Co., Grinnell Corp.
      e. Stockham Valves & Fittings, Inc.

   2. Disinfecting Chemicals: Comply with EPA requirements.
      a. AWWA B300, Hypochlorite.
      b. AWWA B301, Liquid Chlorine.
c. AWWA B302, Ammonium Sulfate.
d. AWWA B303, Sodium Chlorite.
3. Double Check Detector Assembly.
a. Conraco
b. FEBCO
4. Double Check Detector Assembly Enclosure.
a. Hotbox
b. Hydrocowl
5. Reduced Pressure Principle Assembly "Backflow Preventors".
a. Conraco
b. Febco

B. Pipes: Subject to compliance with requirements of authorities having jurisdiction:
1. Polyvinyl Chloride (PVC) Pipe: AWWA C900; Classes 150 and 200; with bell end and elastomeric gasket, with plain end for cast iron and ductile iron fittings, or with plain end for PVC elastomeric gasket fittings.
a. Pipe Marking: NSF 14, NSF-pvc to only.

C. Joining Materials;
1. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

D. Valves:
1. Valves 2 Inches (50 mm) and Larger: AWWA C500, nonrising stem and nut operator or handwheel, double wedge, flanged, grooved, or mechanical ends.
2. Gate Valves, 2 Inches (50 mm) and Smaller: MSS SP 80; bronze body, nonrising stem and handwheel, inside screw, single wedge or disc, threaded ends.

2.2 IDENTIFICATION
A. Metallic Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches (150 mm) wide by 4 mils (1 mm) thick, solid blue in color with continuously printed caption in black letters CAUTION - WATER LINE BURIED BELOW.

PART 3 - EXECUTION

3.1 EARTHWORK
A. Excavation, trenching, and backfilling are specified in Section 02200.

3.2 SERVICE ENTRANCE PIPING
A. Extend water system piping and connect to water supply source and building water distribution and fire protection systems at outside face of the building wall in locations and pipe sizes indicated.
1. Terminate water system piping at building wall until building water systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water systems when those systems are installed.

B. Water distribution systems and fire protection systems are specified in Division 15 Sections.
C. Install restrained joints for buried piping within 5 feet (1.5 m) of building. Use restrained joint pipe and fittings, thrust blocks, anchors, tie rods and clamps, and other supports at vertical and horizontal offsets.
3.3 JOINT CONSTRUCTION

A. AWWA Polyvinyl Chloride (PVC) Piping Gasketed Joints: Use AWWA C900 joining materials. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

B. Polyvinyl Chloride (PVC) Piping Solvent Cement Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.
   1. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.

C. Dissimilar Materials Piping Joints: Construct joints using adapters that are compatible with both piping materials, outside diameters, and system working pressure. Comply with specifications for joining piping of dissimilar metals.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Install piping as indicated except where deviations to layout are approved on coordination drawings.

B. Install piping at indicated slope.

C. Install components having pressure rating equal to or greater than system operating pressure.

D. Install piping free of sags and bends.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install fittings for changes in direction and branch connections.

G. Piping Connections: Make piping connections as specified below.
   1. Install unions, in piping 2 inches (50 mm) and smaller, adjacent to each valve and at final connection to each piece of equipment having 2 inch (50 mm) or smaller threaded pipe connection.
   2. Install flanges, in piping 2-1/2 inches (65 mm) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
   3. Install dielectric fittings to connect piping of dissimilar metals.

3.5 PIPING INSTALLATION

A. Comply with requirements of NFPA 24 for materials and installation.

B. Bury piping at minimum depth of 36 inches (1 m) below finished grade and not less than 18 inches (0.5 m) below average local frost depth.

3.6 ANCHORAGE INSTALLATION

A. Anchorages: Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

B. Apply full coat of asphalt or other acceptable corrosion retarding material to surfaces of installed ferrous anchorage devices.
3.7 VALVE INSTALLATION

A. Application: Use mechanical joint end valves for 3 inch (80 mm) and larger buried installation. Use threaded and flanged end valves for installation in pits and inside building. Use nonrising stem UL/FM gate valves for installation with indicator posts. Use bronze corporation stops and valves, with ends compatible with piping, for 2 inch (50 mm) and smaller installation.

B. AWWA Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast iron valve box.

C. UL/FM Type Gate Valves: Comply with NFPA 24.
   1. Install buried valves and valves in pits with stem pointing up and with vertical cast iron indicator post.

3.8 DETECTOR CHECK VALVE INSTALLATION

A. Align detector check valves for proper direction of flow. Install according to authorities having jurisdiction.

B. Support detector check valves, meters, shutoff valves, and piping on 3000 psi (20.7 MPa) minimum, Portland cement mix concrete.

3.9 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to plumbing and health department authorities having jurisdiction.

B. Do not install bypass around backflow preventer.

C. Do not install reduced pressure principle type in pit.

D. Support backflow preventers, valves, and piping on 3000 psi (20.7 MPa) minimum, Portland/cement mix concrete.

3.10 IDENTIFICATION INSTALLATION

A. Install continuous plastic underground warning tape during back filling of trench for underground water service piping. Locate 6 inches (150 mm) to 8 inches (200 mm) below finished grade, directly over piping.

B. Attach nonmetallic piping label permanently to main electrical meter panel.

3.11 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at minimum 1-1/2 times working pressure for 2 hours.
   1. Increase pressure in 50 psig (350 kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

3.12 CLEANING AND DISINFECTING SYSTEM
A. Inspected and pressure test piping system.

B. Perform scheduling and disinfecting activity with start up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

C. Clean and disinfect water distribution piping:
   1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
   2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if method is not prescribed by that authority, use procedure described in AWWA C651 or as described below:
   3. Comply with NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
   4. Fill system or part of system with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) system or part thereof and allow to stand for 24 hours.
   5. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine; isolate and allow to stand for 3 hours.
   6. Following allowed standing time, flush system with clean, potable water until chlorine does not remain in water coming from system.
   7. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by authority shows evidence of contamination.

D. Prepare reports for purging and disinfecting activities.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Disinfection of on-site potable water system, including service mains to the building.

B. Test and report results.

1.2 PROJECT RECORD DOCUMENTS

A. Submit reports to authorities having jurisdiction.

B. Disinfection report; accurately record:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and time of completion.
   3. Test locations.
   4. Initial and 24 hour disinfectant residual (quantity in treated water) in ppm for each outlet tested.
   5. Date and time of flushing start and completion.
   6. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report; accurately record:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.
   7. Certification that water conforms, or fails to conform, to bacterial standards of State of Nevada.
   8. Bacteriologist's signature.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXECUTION

A. Provide and attach equipment required to execute work of this Section.

B. Inject treatment disinfectant into piping system.

C. Circulate and flush repeatedly until required cleanliness is achieved.

D. Flush and clean with municipal domestic water.

E. Replace permanent system devices removed for disinfection.
F. Pressure test system to 150 psi unless higher pressures are required by authorities having jurisdiction. Repair leaks and retest.

3.2 TESTS

A. Provide testing of treated water per requirements of authorities having jurisdiction.

B. Test Samples in accordance with ANSI/AWWA C651.

END OF SECTION
SECTION 02 7 30
SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Sanitary sewer system including but not limited to:
   1. Tie into and extend existing sanitary sewerage system piping and appurtenances.
   2. Accessories required for a complete installation.

1.2 RELATED WORK:

A. Geotechnical Report-Published Separately
B. Section 02225 - Trenching.
C. Division 15 - Mechanical Work.

1.3 REFERENCES

B. Geotechnical Report.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   3. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
   4. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage systems.

B. Manufacturers Qualifications: Firm having minimum 5 years documented experience in manufacturing sanitary sewer products.

1.5 SUBMITTALS

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements
B. Product Data: Drainage piping specialties.
C. Coordination drawings showing pipe sizes and cleanouts, locations, and elevations. Include details of underground structures and connections. Show other piping in the same trench and clearances from sanitary sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
D. Coordination profile drawings showing sanitary sewerage system piping in elevation. Draw
profiles at a horizontal scale of minimum 1 inch equals 50 feet and a vertical scale of minimum 1 inch equals 5 feet. Indicate pipe and underground structures. Show types, sizes, materials, and elevations of other utilities crossing sewerage system piping.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site survey, and verify existing utility locations. Verify storm sewerage system piping may be installed in compliance with original design and referenced standards.
   1. Locate existing sanitary sewerage system piping and structures that are to be connected into, and abandoned and closed.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate relocation of existing sewer to avoid interruption of service.
B. Coordinate with interior building sanitary drainage piping.
C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturers: Provide products complying with requirements of one of the following:
   1. Cleanouts:
      a. Ancon, Inc.
      b. Josam Co.
      d. Wade Div.; Tyler Pipe.
      e. Zurn Industries, Inc.; Hydromechanics Div.
   2. Underground Warning Tapes:
      c. Carlton Industries, Inc.
      d. EMED Co., Inc.
      e. Seton Name Plate Co.

2.2 PIPE AND FITTINGS

A. Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.

B. Hub and Spigot Cast Iron Soil Pipe and Fittings: ASTM A74, gray cast iron, for compression gasket joints.
   2. Gaskets: ASTM C564, rubber, thickness to match class of pipe.

C. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: Size and thickness to match existing.
   1. ASTM D2729, bell and spigot solvent sealed ends.
   2. ASTM D3033, Type PSP, bell and spigot solvent sealed ends.
   3. ASTM D3034, SDR 35, bell and spigot solvent sealed ends.
   5. Gaskets: ASTM F477, elastomeric seal.

D. Reinforced Concrete Sewer Pipe and Fittings: ASTM C76, Class II, Wall B, for rubber gasket
joints, bell and spigot.

E. Nonreinforced Concrete Sewer Pipe and Fittings: ASTM C14, Class 2, for rubber gasket joints.

2.3 CLEANOUTS

A. Provide cast iron ferrule and countersunk brass cleanout plug, with round cast iron access frame and heavy duty, secured, scoriated cast iron cover.

2.4 IDENTIFICATION

A. Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters CAUTION - SEWER LINE BURIED BELOW.

B. Metallic Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters CAUTION - SEWER LINE BURIED BELOW.

PART 3 - EXECUTION

3.1 PREPARATION OF FOUNDATION FOR BURIED SANITARY SEWERAGE SYSTEMS

A. Grade trench bottom to provide a smooth, firm, stable, and rock free foundation, throughout length of pipe.

B. Remove unstable, soft, and unsuitable materials at surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.

C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve bells of all loads and to ensure continuous bearing of pipe barrel on foundation.

3.2 INSTALLATION

A. General Locations and Arrangements: Drawings (plans and details) indicate general location and arrangement of underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated to extent practical.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer’s recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. Use cleanouts for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.

D. Use proper size increaser, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of size of piping in direction of flow is prohibited.

E. Building sewers shall be run in impractical alignment and at a uniform slop of not less than one-
forth (1/4) of an inch per foot toward the point of disposal. Except when approved by the Administrative Authority and where it is impractical, due to the depth of the street sewer or to the structural features or to the arrangement of any building or structure, to obtain a slope of one-fourth (1/4) of an inch per foot, any such pipe or piping four (4) inches through six (6) inches may have a slope of not less than one-eighth (1/8) of an inch per foot and any such piping eight (8) inches and larger may have a slope of not less than one-sixteenth (1/16) of an inch per foot.

F. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. Join and install PVC pipe as follows:
   1. Solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D2855 and ASTM F402.
   2. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D3212.
   3. Installation in accordance with ASTM D2321.

B. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.4 CLEANOUTS

A. Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18” x 18” x 12” deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving.

3.5 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished work will conform as nearly as practicable to requirements specified for new work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6 inch overlap, with minimum 6 inches of 4500 psi 28 day compressive strength concrete.

C. Make branch connections from side into existing 4 to 21 inch piping by removing section of existing pipe and installing wye fitting, into existing piping. Encase entire wye with minimum 6 inches of 3000 psi 28 day compressive strength concrete.

D. Make branch connections from side into existing 24 inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
   1. Provide concrete attaining minimum 28 day compressive strength of 3000 psi.
   2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.

E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.6 INSTALLATION OF IDENTIFICATION
A. Install continuous plastic underground warning tape during back filling of trench for underground sanitary sewer piping. Locate 6 to 8 inches below finished grade, directly over piping.

3.7 FIELD QUALITY CONTROL

A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
   1. In large, accessible piping, brushes and brooms may be used for cleaning.
   2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
   3. Flush piping between cleanouts, if required by local authority, to remove collected debris.

C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
   1. Make inspections after pipe between cleanouts and cleanout locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
   2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.

D. In order to check for line defects, and independent third-party contractor herein referred to as the Videotaping Company shall be hired by the Owner to perform videotaping of sanitary sewer lines, provide written certification of videotape accuracy, and provide a written catalogue of deficiencies. If the pipes are constructed per Project Drawings and Specifications, the catalogue of deficiencies should state, “No defects detected”.
   1. The Videotaping Company shall televise/videotape all sanitary sewer lines between manholes, excluding laterals to the building.
   2. The videotaping shall be done after the sanitary sewer lines have been completely backfilled and compacted, but prior to paving. The Contractor will give the Owner a minimum of ten working days written notice when the sanitary sewer lines are ready to be televised.
   3. The Videotaping Company shall use a color television camera and video taping equipment with time stamp and date features. The videotape shall be annotated to show date, time, and pipe identification; each sanitary sewer line will be identified on the tape as to location on the project site.
   4. Videotaping provided by the Videotaping Company shall be completed in accordance with National Association of Sewer Service Companies (NASSCO’s) specifications.
   5. Two copies of the certified and annotated videotape will be produced and delivered to the Architect, Project Manager, and State Inspector. The written certification of videotape accuracy and catalogue of deficiencies shall accompany each copy. Once the videotaping has been completed, reviewed, and accepted by the Owner Representative, the Owner will sign a document accepting the work.

E. Testing procedures and results shall be observed and verified by a representative of the Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Traffic marking and striping for pavement and curbs as shown on Drawings.

1.2 SUBMITTALS
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements
B. Product Data: Submit Manufacturer’s specifications for paint.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Traffic Surface Paint: Provide one of following or as approved.
   1. Dunn-Edwards: Vin-L-Stripe W8D1 Series acrylic latex.
   3. ICI Dulux: 22683 (white), 22685 (yellow), 26564 (red) or 20090 (handicap blue) ICI Performance Coatings waterborne traffic paint.
   5. Pervo: 3080 (white), 3082 (yellow), 3083 (green) or 3084 (black) Water Borne Traffic Coating and 3033 Dark Handicap Blue Traffic Line Paint - WaterBorne.

B. Colors: As follows:
   1. Stall Striping: Traffic White
   2. Handicap Markings: Traffic Blue
   3. Fire Lanes: Red
   4. Playground game areas: Traffic White

PART 3 - EXECUTION

3.1 EXAMINATION
A. Prepare chalk layout and obtain Owner approval prior to start of marking and striping.

3.2 PREPARATION
A. Thoroughly clean surfaces of substances which may inhibit bonding.

3.3 APPLICATION
A. Apply paint with equipment suited for that purpose in accordance with Manufacturer's directions.
B. Paint lines straight and true to pattern layout. Correct errors by sandblasting. Apply two coat minimum or more if required to obtain complete opacity. Dry film thickness: 8 mils minimum.
C. Stall Divisions: Provide between standard size parking stalls, a single 4 inch wide stripe, stall width as shown on Drawings.
D. Arrows and Pavement Signs: Paint directional arrows with stencils or other approved method. Strokes of letters, islands and "No Parking" areas to have 3 inch wide strips.

E. Handicap Stalls: Provide symbol and other markings as approved by Architect.

F. Fire Lanes: Provide red painted curbs as required.

G. Protect completed Work until dry.

END OF SECTION
SECTION 02 7 65
PAVEMENT MARKINGS

PART 1 – GENERAL

1.1 SUMMARY
A. Section Includes: Traffic marking and striping for pavement and curbs as shown on Drawings.

1.2 SUBMITTALS
A. Product Data: Submit Manufacturer's specifications for paint.

PART 2 – PRODUCTS

2.1 MANUFACTURERS
A. Traffic Surface Paint: Provide one of following or as approved.
   1. Dunn-Edwards: Vin-L-Stripe W8D1 Series acrylic latex.
   3. ICI Dulux: 22683 (white), 22685 (yellow), 26564 (red) or 20090 (handicap blue) ICI Performance Coatings waterborne traffic paint.
   5. Pervo: 3080 (white), 3082 (yellow), 3083 (green) or 3084 (black) Water Borne Traffic Coating and 3033 Dark Handicap Blue Traffic Line Paint - WaterBorne.

B. Colors: As follows:
   1. Stall Striping: Traffic White
   2. Handicap Markings: Traffic Blue
   3. Fire Lanes: Red
   4. Playground game areas: Traffic White

PART 3 – EXECUTION

3.1 EXAMINATION
A. Prepare chalk layout and obtain Owner approval prior to start of marking and striping.

3.2 PREPARATION
A. Thoroughly clean surfaces of substances which may inhibit bonding.
3.3 APPLICATION

A. Apply paint with equipment suited for that purpose in accordance with Manufacturer's directions.

B. Paint lines straight and true to pattern layout. Correct errors by sandblasting. Apply two coat minimum or more if required to obtain complete opacity. Dry film thickness: 8 mils minimum.

C. Stall Divisions: Provide between standard size parking stalls, a single 4 inch wide stripe, stall width as shown on Drawings.

D. Arrows and Pavement Signs: Paint directional arrows with stencils or other approved method. Strokes of letters, islands and "No Parking" areas to have 3 inch wide strips.

E. Handicap Stalls: Provide symbol and other markings as approved by Architect.

F. Fire Lanes: Provide red painted curbs as required.

G. Protect completed Work until dry.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valves, piping, emitters, specialties, accessories, controls, and wiring for a drip irrigation system.
   2. Accessories required for a complete installation.

1.2 RELATED SECTIONS:

A. Section 02900 – Landscape Work.
B. Division 16 Electrical Work.

1.3 SYSTEM DESCRIPTION:

A. Electric solenoid controlled underground irrigation system.
B. Source Power: 120 volt.
C. Low Voltage Controls: 24 volt.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable codes for piping and component requirements.
B. Provide certificate of compliance from authority having jurisdiction indicating approval of products.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Location of Sprinklers and Devices: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards.
B. Minimum Water Coverage:
   1. Drip Areas: Number and size of emitters as noted on plans.
C. Components and Installation: Capable of producing piping systems with minimum working pressure ratings except where indicated otherwise.
   1. Pressure Piping: 150 psi.
   2. Circuit and Drain Piping: 100 psi.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   1. Provide certificate of compliance from authority having jurisdiction indicating approval of products in system.
   2. Comply with requirements of utility supplying water for backflow prevention and back siphonage.
B. Installer Qualifications: Installer having minimum 5 years documented experience in irrigation
systems similar in material, design, and extent to work indicated and having a successful service record. Licensed in the state in which work is to be performed.

C. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.

1.7 SUBMITTALS
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements

B. Product Data: Pressure rating, rated capacity, settings, and electrical data of selected models for the following:
   1. Pressure regulators.
   2. Valves, including general duty, underground, manual and automatic control, and quick coupler types, and valve boxes.
   3. Sprinklers, including emitters, drip tubes, and devices.

C. Record Drawings: Record actual locations of all concealed components, piping systems, conduit and wiring.

1.8 PROJECT CONDITIONS
A. Perform site survey, research public utility records, and verify existing utility locations. Verify irrigation system piping may be installed in compliance with original design and referenced standards.

B. Verify field measurements are as indicated on drawings. Notify Owner’s representative of any discrepancies prior to commencing work.

1.9 SEQUENCING AND SCHEDULING
A. Maintain uninterrupted water service to building during normal working hours. Arrange for temporary water shutoff with Owner.

B. Maintain uninterrupted water service to the surrounding existing landscape. Arrange for temporary water shutoff with Owner. Provide temporary irrigation to existing landscape if needed.

C. Coordinate work with site backfilling, landscape grading and delivery of plant material.

1.10 EXTRA MATERIALS
A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below. Package them with protective covering for storage and label clearly describing contents.
   1. Emitters: Ten each.
   2. Valve Keys: Two each.

1.11 WARRANTY
A. Warranty all parts and labor for a period of one year from date of substantial completion.
   1. Repair damage to landscape due to settling of trenches.
   2. Fill and repair depressions.
   3. Repair damage to premises caused by defective components.
   4. Make repairs within seven days of notification.
B. The contract documents govern replacement materials, labor, and workmanship identically as with new work. Make replacements at no additional cost to owner.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Manufacturers: Firm specializing in the manufacture of PVC pipe.

B. PVC Pipe: ASTM D2411; Schedule 40; solvent welded sockets for pipe 3 inch diameter and smaller.

C. Fittings: Schedule 40 fittings.

D. Solvent Cement: ANSI/ASTM D2564 for PVC pipe and fittings.

E. Sleeve Material: PVC Schedule 40.

2.2 PIPE FITTINGS

A. Cast Bronze Flanges: ASME B16.24, Class 150, raised ground face, bolt holes spot faced.

B. PVC Pipe Fittings: Schedule 80, threaded type.

C. PVC Pipe Fittings: Schedule 40, socket type.

D. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion. These devices are a combination of copper alloy and ferrous metal, threaded or flanged end types, matching piping system materials.
   1. Dielectric Unions: Factory fabricated, union assembly, designed for 250 psi minimum. Working pressure at 180 degrees F. Include insulating material isolating dissimilar metals and ends with inside threads.
   2. Dielectric Flanges: Factory fabricated, companion flange assembly for 300 psi minimum pressure to suit system pressures.
   3. Transition Fittings: Manufactured assembly or fitting, with pressure rating at least equal to that of system and with ends compatible to piping where fitting is to be installed.

2.3 JOINING MATERIALS

A. Solvent Cement: ASTM F 656 primer and ASTM D 2564 Solvent cement in color other than orange for rigid PVC pipe to PVC fittings, use only 795 solvent cement for flexible PVC pipe to PVC fittings.

B. Gaskets and Fasteners for Metal and Metal to Plastic Flanged Joints: ASME B16.21, nonmetallic, asbestos free, flat, 1/8 inch thickness gaskets, carbon steel bolts, nuts, and washers. Use flanged fittings in above grade applications and push-on ring-tight fittings in below grade applications.

C. Gaskets for Plastic Flanged Joints: Materials recommended by plastic pipe and fittings manufacturer.

D. Threaded Joints: Use only teflon tape type pipe joint sealant on plastic threads.
2.4 MANUAL VALVES

A. Gate Valves: Waterous or Nibco brass or ductile iron, non-rising stem, inside screw with threaded ends.

B. Valve Box Cover: Ametek, Carson or approved equal. Plastic valve boxes. Use “Jumbo” valve boxes on drip valve assemblies for easier access. Use tan valve boxes in planter areas and green valve boxes in grass areas.

C. Quick Couplers: Factory fabricated, two piece assembly, with non-potable purple cap. Include coupler water seal valve with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key. Include vandal resistant, locking feature with matching key.

2.5 REMOTE CONTROL VALVES

A. Normally closed, 24 VAC, 50/60 cycle solenoid actuated globe pattern with balanced pressure diaphragm design, pressure rating of 200 PSI minimum. Constructed of red brass with stainless steel studs and flange nuts. Diaphragm to be nylon reinforced rubber. Internal bleed manual open/close control. Manual flow control with brass stem.

B. Valve Boxes: Carson, Ametex, Brooks or equal, rectangular heavy duty valve box with lockable lids. Use “jumbo” size valve boxes for drip valve assemblies and adjustable extensions of length required for depth of bury of valve. Valve boxes for drip valve assemblies are to be oversized so that the entire drip valve assembly is easily accessible and removable without disturbing the valve box. Use green colored valve boxes in grass areas and tan colored valve boxes in shrub areas.

C. Label each valve with the controller and station number on a water proof Christy tag.

D. Brand all valve box lids with valve number, type of valve or connection.

2.6 EMMITTERS AND DEVICES

A. Pressure Regulators: Plastic housing, one inch size, with corrosion resistant internal parts, and capable of controlling outlet pressure to approximately 30 psi.

B. Strainer / Filter Units: Plastic housing with corrosion resistant internal parts and 200 mesh screens.

C. Emitters: Plastic threaded body with single outlet.

D. Drip Tubes: Flexible thick walled PVC tube for emitters or other devices indicated, of length indicated. Salco, Bowsmith, GPH or equal of ½" IPS size. Use with ½" PVC fittings and 795 glue.

E. Drip Header: PVC pipe, PVC 1120, Schedule 40.

F. Other devices: As specified and as indicated.

2.7 AUTOMATIC CONTROL SYSTEM

A. Low voltage controller system, made for control of irrigation system automatic control valves. Controller operates on 120 volts a.c. building power system, provides 24 volts a.c. power to control valves, and includes stations for at least the number of control valves indicated. Must be compatible with specified central control system.
B. Control Enclosures: Weatherproof enclosure with locking cover and two matching keys. Enclosure construction complies with NFPA 70 and NEMA 250, Type 4, and includes provisions for grounding.

C. Wiring: UL 493, solid copper conductor, insulated cable, suitable for direct burial.
   1. Feeder Circuit Cables: Type UF, No. 12 AWG minimum, between building and controllers.
   2. Low Voltage and Branch Circuits: Type UF, No. 12 AWG minimum, common wire, white color and No. 14 AWG minimum pilot wire, color other than white.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify location of existing utilities.

B. Verify required utilities are available, in proper location, and ready for use.

C. Verify available water supply water pressure and flow characteristics.

3.2 PREPARATION

A. Set stakes to identify proposed mainline locations. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures. Obtain Owner's Representative's approval before excavation.

B. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system.

3.3 TRENCHING

A. Excavate, trench, and backfill as specified in Section 02200.

B. Trench Depths:
   1. Minimum Cover Over Sleeves: 18 inches.
   4. Minimum Cover Over Installed Drip Tubing: 12 inches.

C. Trench to accommodate grade changes.

D. Maintain trenches free of debris, material, or obstructions that may damage pipe.

3.4 PIPING APPLICATIONS

A. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and above ground may be joined with flanges instead of joints indicated.

B. Pressure Piping Aboveground:
   1. Brass or copper piping and fittings. Installed per manufacturer's written instructions.

C. Pressure Piping Underground:
1. 3 Inches and Smaller: PVC schedule 40 with solvent cemented fittings.

D. Lateral Piping:
1. All Sizes: PVC schedule 40 with solvent cemented fittings.

E. Drip Tubing: Thick walled flexible PVC pipe with solvent cemented fittings (Salco, GPH or equal).

F. Sleeves: PVC schedule 40. Use solvent cemented coupler type fittings only where spans are greater than 20’.

3.5 JOINT CONSTRUCTION

A. Threaded Joints: Thread pipes with tapered pipe threads, apply tape or joint compound, and apply wrench to valve ends into which pipes are being threaded.

B. Polyvinyl Chloride (PVC) Piping Solvent Cemented Joints: Construct joints free of burrs.
   1. Handle Solvent Cements, Primers, and Cleaners in a safe and legal manner.
   2. Apply primer to outside of pipe and inside of fitting, apply solvent cement to outside of pipe and inside of fitting taking care not to use an excessive amount. Insert pipe into fitting and rotate one-quarter turn to evenly spread cement around entire contact surface. Wipe away excess glue, do not allow excess glue to restrict flow through inside of pipe or fitting.

C. Dissimilar Materials Piping Joints: Construct joints using adapters compatible with both piping materials, outside diameters, and system working pressure.

3.6 PIPING SYSTEMS COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved by owner's representative.

B. Install components having pressure rating equal to or greater than system operating pressure.

C. Install piping free of sags and bends.

D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

3.7 PIPING INSTALLATION

A. Install pipe, valves, controls, and outlets in accordance with manufacturer’s instructions.
   1. Connect to utilities.
   2. Set outlets and box covers at finish grade elevations.
   3. Provide for thermal movement of components in system.
   4. Use threaded nipples for risers to each outlet.
   5. Install control wiring in accordance with Division 16. Provide 10 inch expansion coil at each valve to which controls are connected, and at 100 ft intervals. Bury wire beside pipe.
   6. Coordinate pipe installation with electrical work and conduit installation.

B. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
C. Install piping and wire under sidewalks, walls and paving in sleeves.

D. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

3.8 VALVE INSTALLATION
A. Valves: Install underground valves in valve boxes. Only one valve per valve box.
B. Control Valves: Install in valve boxes, arranged for easy adjustment and removal. Only one valve per valve box.

3.9 EMITTER INSTALLATION
A. Emitters: Flush circuit piping with full head of water and install emitters after hydrostatic test is completed.
   1. Install emitters as indicated on drawings. Place all emitters at the perimeter of the rootball of each plant. Place the emitters ½” above finish grade.

3.10 AUTOMATIC CONTROL SYSTEM INSTALLATION
A. Connect new valves to existing automatic control and wire.

3.11 CONNECTIONS
A. Connect piping to sprinklers, devices, valves, control valves, specialties, and accessories.
B. Connect water supplies to irrigation systems. Include backflow preventers on potable water supplies.
C. Minimum requirements for electrical installations are specified in Division 16.

3.12 BACKFILLING
A. Provide 2 inch sand cover around piping. Backfill trench and compact to sub-grade elevation. Compact trenches under paving to 95%. Compact trenches in landscape areas to 85%. Protect piping from displacement.

3.13 CLEANING AND ADJUSTING
A. Flush dirt and debris from piping before installing emitters and other devices.
B. Adjust automatic control valves to provide flow rate and pressure required for each irrigation circuit.
C. Adjust settings of controllers, pressure regulators and automatic control valves.

3.14 COMMISSIONING
A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:
   1. Verify specialty valves and their accessories have been installed correctly and operate correctly.
   2. Check emitters and devices are correct type.
   3. Check damaged emitters and devices have been replaced with new materials.
B. Operational Testing: Perform operational testing in the presence of the Owner’s Representative after hydrostatic testing is completed, backfill is in place, and emitters are adjusted to final position.

3.15 DEMONSTRATION

A. Demonstrate to Owner’s Representative that system meets coverage requirements and that automatic controls function properly.

B. Demonstrate to Owner's maintenance personnel operation of equipment, emitters, specialties, and accessories. Review operating and maintenance information.

C. Provide 7 days' written notice in advance of demonstration.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Chain-link fences.
   2. Gates.

1.2 RELATED SECTIONS:

A. Section 03300 - Cast-in-Place Concrete: for cast-in-place concrete post footings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: Submit Manufacturer's data for fencing and gate materials, including details of construction and concrete footings.

B. Certificates: Submit certification from Manufacturer that galvanizing and coatings conform to the requirements in this Section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain Link Fabric:
   1. ASTM A392, fabricated with 0.148 inch (9 gauge) nominal uncoated wire diameter woven in a 2 inch diamond mesh.
   2. Top and bottom edges shall have a knuckled finish.
   3. Fabric shall be continuous width for full height of fence.
   5. Hot-dip galvanize before fabrication.
   6. Height: As indicated on drawings.

B. Posts: Type I shall be Schedule 40 steel pipe conforming to ASTM F1083 or Type II shall be steel pipe conforming to F669, Group IC, with coating conforming to the requirements of ASTM F1234 Type B exterior and Type B galvanized interior, galvanized before forming.
   1. Intermediate Line Posts: 2.375 inch (60.3mm) O.D. zinc coated steel pipe; Type I weighing 3.65 pounds per lineal foot (5.4 kg/m) or Type II weighing 3.12 pounds per lineal foot (4.6 kg/m).
   2. Terminal and Corner Posts: End, corner and pull posts shall be 2.875 inches (73.0mm) O.D. zinc coated steel pipe; Type I weighing 5.79 pounds per lineal foot (8.6 kg/m) or
Type II weighing 4.64 pounds per lineal foot (6.8 kg/m).
3. Gate Posts: 4 inches O.D. zinc coated steel pipe; Type I weighing 9.10 pounds per lineal foot or Type II weighing 6.56 pounds per lineal foot.
4. Brace Struts: 1.660 inches (42.2mm) O.D. nominal 1-1/4 inch (31.75mm) zinc coated steel pipe; Type I weighing 2.27 pounds per lineal foot (4.0 kg/m) or Type II weighing 1.82 pounds per lineal foot (3.2 kg/m), with couplings and heavy duty, spring-loaded couplings.
6. Top Rails: As specified for brace struts.
7. Post Tops: Galvanized, heavy malleable iron with base apron to fit over posts, and designed for use with top rail.

C. Truss Rod: 3/8 inch (9.5mm) round steel rod fitted with turnbuckle.
D. Tension Wire: No. 7 (4.5mm) steel wire; ASTM A824 Type II, Class 2 zinc coating.
E. Fittings: Galvanized, malleable cast iron or pressed steel meeting ASTM F626.
F. Gate Hardware: Provide the following hardware and accessories for each gate:
1. Hinges: Pressed steel or malleable iron to suit gate size, non-liftoff-type, offset to permit 180-degree gate opening.
2. Latch: Forked type or plunger-bar type to permit operation from either side of gate. Provide padlock eye as integral part of latch.
3. Keeper: Provide keeper for vehicle gates, which automatically engages the gate leaf and holds it in the open position until manually released.
4. Guide and Guide Channel: Steel, including required brackets, channels, mounting angles and mounting hardware. Roller guides shall be heavy duty, neoprene wheels.
5. Double Gates: Provide gate stops for double gates, consisting of mushroom type or flush plate with anchors. Set in concrete to engage the center drop rod or plunger bar. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

1. Chain link fabric: 1.2 ounces per square foot.
2. Rails, posts and braces: 1.8 ounces per square foot for Type I steel pipe and a minimum weight of 0.90 ounces per square foot for Type II steel pipe. Type II steel pipe shall have an exterior chromate conversion and a minimum of .3 mils clear polymer applied over the zinc coating.

H. Concrete Footings: 2500 psi (17 MPa) unless otherwise noted on Drawings, and meet requirements of Section 03300.

2.2 FABRICATION
A. Swing Gates:
1. Fabricate gate frames from 1-1/2 inch (38mm), (1.900 inch (48.4mm) nominal outside diameter) steel pipe; Type I nominal weight 2.72 pounds (1.23kg) per foot (300mm) or Type II nominal weight 2.28 pounds (1.03kg) per foot (300mm) of welded construction or constructed with heavy malleable iron or pressed steel corner fittings securely riveted. Weld areas shall be cleaned and repaired using 2 coats of zinc rich paint.
2. Install wire fabric to match the fence in frame by means of tension bars and hook bolts.
3. Each frame to be equipped with 3/8 inch diameter adjustable truss rods.
4. Bottom hinges to be ball and socket type designed to carry the weight of the gate on the post footing.
5. Upper hinge to be wrap around adjustable type.
6. Equip gates with a positive type latching device with provision for padlocking.
7. Drive swinging gates to be provided with center plunger rod, catch and semi-automatic outer catches to secure gates in opened position.
8. Equip rolling gates with stops, keepers, rollers and roller tracks.

B. Sliding Rolling Gates:
1. Frame shall be 2.875 inches O.D. steel pipe; Type I weighing 5.79 pounds per lineal foot or Type II weighing 4.64 pounds per lineal foot per lineal foot.
2. Weld and brace frame joints wherever necessary.
3. Cover with fabric to match fence and provide with locking device to receive padlock.
4. Sliding gate track shall be 1 1/4 inches x 1 1/4 inches x 3/16 inch steel angle, cast onto a 3'-0" wide x 1'-0" thick concrete pad, continuous along the entire rolling length of the wheels.

C. Galvanizing: Except where otherwise noted, materials shall be heavily galvanized after fabrication by hot-dip process.

D. Welding:
2. Electrodes shall be suitable for conditions of intended use.
3. Make joint surfaces free from fins and tears and grind rough surfaces smooth.
4. Clean welded surfaces and treat with two coats of galvanized paint applied per paint Manufacturer's directions.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILLING

A. Perform excavation and backfilling required for setting of concrete post footings. Generally conform to applicable requirements of Section 02300.

3.2 CONCRETE FOOTINGS

A. Concrete Footing Sizes shall be as follows:
   1. End Gate and Corner Posts: 12 inches (300mm) diameter by 36 inches (900mm) deep post embedment.
   2. Line Posts: 9 inches (225mm) diameter by 36 inches (900mm) deep post embedment.
   3. Footing Tops: Shall be troweled smooth and beveled or crowned to drain moisture away from posts. Lower edge of bevel shall meet established finish grade.

3.3 ERECTION

A. Securely anchor fencing plumb, true to line, complete with necessary standard fittings specified and recommended by Manufacturer and in accordance with ASTM F567.

B. Posts: Embed in concrete footings, to depths specified and accurately located as to alignment and grade.

C. Line Posts: Space equally at 10 feet on centers maximum, unless otherwise indicated on the Drawings.

D. Top Rail: Pass through top of line posts and provide a continuous brace from end to end of each stretch of fence. Install outside sleeve type couplings at not more than 20 feet (6m) on center, with every 5th coupling a spring-loaded coupling. Fasten to terminal posts with suitable steel connections.
E. Brace, Struts: Install at mid-point between top of fence and ground, and extend from terminal post with tension return rods.

F. Fencing:
   1. Erect in accordance with ASTM F567 so bottom of fabric is 2 inches above level of the ground or paving and top of fabric is aligned with tops of fence post or top rail.

G. Tension Wire: Stretch along bottom of fence in lengths not exceeding 150 feet (45m) and securely tied to fabric 18 inches (450mm) on center. Provide turnbuckles for each 150 lineal feet (45m) of wire. Secure ends of tension wire to posts in a manner to prevent slipping and insure proper tension. Secure tension wire shall be secured to fabric with No. 12 gauge (1.6mm) galvanized tie wire, double-wrapped at 18 inch (450mm) intervals.

H. Tie Wires: Double-knuckle so exposed ends will not present a hazard.

3.4 CLEANING

A. During the course of the Work and on completion of the Work, remove excess materials, equipment and debris and dispose of away from premises. Leave Work in clean condition.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes wheel stops.

1.2 SUBMITTALS
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements
   B. Product Data: Submit manufacturer's product data.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Precast Parking Bumpers:
      1. Commercially produced precast units
      2. Smooth surface finish
      3. 3 pad bearing surfaces.
      4. Construct of 3000 psi (at 28 days) concrete.
      5. Length: 72 inches long curb
      6. Configuration: 8 inches wide by 6 inches high with 4 vertical sides angled one inch and a ¾ inch minimum to 1 inch maximum radius at top corners
      7. Provide two No. 3 reinforcing bars conforming to Section 03200 continuous through the length of the curb (69 inch overall length, each.)
      8. Provide 5/8 inch diameter hole at 4 inches from each end to allow for a pin.
   B. Hold-down Pins: ASTM A615, Grade 40, plain steel bar, ½ inch diameter, 24 inches long.

PART 3 -

PART 4 - EXECUTION

4.1 INSTALLATION
   A. Install bumpers at locations indicated on Drawings.
   B. Concrete Pavement Areas: Install each unit with epoxy adhesive. Use adhesive in accordance with manufacturer's printed instructions.
   C. Asphalt Pavement Areas: Install each unit with hold-down pins driven through pavement.

END OF SECTION
SECTION 02 8 90
TRAFFIC CONTROL SIGNS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit product data, shop drawings and samples in accordance with Section 01330.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metals: New stock, free from defects impairing strength, durability or appearance.


C. Paints: Type made for the surface material on which it is to be applied and recommended by the manufacturer of the paint. No paint that will fade, discolor or delaminate as a result of proximity to UV light sources or heat therefrom shall be used.

D. Signage Supports: Steel pipes with welded steel caps. Paint with acrylic polyurethane enamel.

2.2 FABRICATION

A. Fabricate in accordance with Clark County Area Standard Details and as indicated on Drawings.

B. Shop/Factory/Finishing:
   1. Paint shall be thoroughly and evenly applied and shall be well worked into corners and joints and shall not have edge or joint buildups.
   2. Paint shall be evenly applied and without pinholes, scratches, orange peeling, application marks, etc.
   3. Workmanship in connection with finishes shall conform to the standard of the trade. Prime coats or other surface pre-treatments, where recommended by the manufacturer for paints, shall be included in the work.

PART 3 - EXECUTION

3.1 ERUCTION, INSTALLATION, APPLICATION

A. Install items square, plumb, true and accurately fitted. Leveling is to be done only by instruments.

B. Embed signage support pipes in concrete filled holes as detailed.

3.2 CLEANING

A. After installation, surfaces marred during erection, and exposed bolts, bolt heads, etc., shall be retouched with the same paint used previously.

END OF SECTION
SECTION 02900
LANDSCAPE WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Trees.
   2. Shrubs.
   3. Plants.
   4. Ground cover.
   5. Soil amendments.
   6. Initial maintenance of landscape materials.
   7. Accessories required for a complete installation.

1.2 RELATED WORK:

A. Division 2 – Site Work.

1.3 REFERENCES

A. American Nursery Association (ANA) Guidelines.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements, Codes, and Standards:
   1. Comply with appropriate regulatory agencies for fertilizer and herbicide composition.

B. Source Quality Control:
   1. Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
   2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Owner’s Representative, together with proposal for use of equivalent material.
   3. Analysis and Standards: Package standard products with manufacturer’s certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
   4. Topsoil: Before delivery of topsoil, furnish Owner’s Representative with written statement giving location from which topsoil is to be obtained and an agricultural analysis of the topsoil to be used.
   5. Trees, Shrubs and Plants: Provide trees, shrubs, and plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 American Standard for Nursery Stock. Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, or disfigurement.
   6. Label at least ten percent of trees and shrubs of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
      a. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.
7. Inspection:
   a. Trees and Shrubs: The Owner’s Representative may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Owner’s Representative retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

C. Sole Source Responsibility: Subcontract landscape work to a single firm specializing in landscape work. Licensed in the state in which work is to be performed.
   1. Nursery: Firm specializing in growing and cultivating plants with minimum 5 years documented experience.
   2. Tree, Plant, Ground Cover Installer: Firm specializing in installing and planting the plants with minimum 5 years documented experience approved by nursery.

D. Coordinate with installation of underground sprinkler system piping and watering heads.

1.5 SUBMITTALS

A. Plant and Material Certifications:
   1. Certificates of inspection required by governmental authorities.
   2. Manufacturer’s or vendor’s certified analysis for soil amendments and fertilizer materials.
   3. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.

B. Planting Schedule: Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

C. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period.

D. Submit copies of all invoices or receipts for materials used on the project which cannot be visually verified. These include, but are not limited to, backfill mix material, fertilizer, fertilizer tablets, mulches, seed, soil stabilizers, water holding agents, herbicides, etc. All invoices or receipts must list the item, quantity, job location, date and the supplier.

E. Agricultural Soil Analysis: Contractor is to obtain an agricultural soil analysis of both the import and the on-site soil from a lab specializing in agricultural soil analysis. The analysis is to recommend specific soil amendments and fertilizer applications. Submit the results to the Landscape Architect for review. The soil mix noted on the plans will be changed or altered according to the recommendations of the soil lab and the instructions of the Landscape Architect at no additional cost.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

B. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by the Owner’s Representative. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective
covering during delivery.

C. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.

D. Do not remove container grown stock from containers until planting time.

1.7 PROJECT CONDITIONS

A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner's Representative before planting.

C. Weather Conditions:
   1. Do not install plant life when ambient temperatures may drop below 35 degrees F or above 100 degrees F.
   2. Do not install plants when wind velocity exceeds 25 mph.

1.8 SEQUENCING AND SCHEDULING

A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
   1. Plant or install materials during normal planting seasons for each type of plant material required.
   2. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.

1.9 WARRANTY

A. Warranty all plant material and related landscape work for a period of ninety (90) days after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control.

B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of Owner's Representative, it is advisable to extend warranty period for a full growing season.
   1. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

1.10 MAINTENANCE SERVICE

A. Maintain plant life for ninety (90) days after Date of Substantial Completion.

B. Maintenance to include (but not limited to):
   1. Cultivation and weeding plant beds and tree pits.
   2. Fertilizing trees and shrubs every 90 days.
   3. Applying herbicides for weed control in accordance with manufacturer's instructions.
Remedy damage resulting from use of herbicides.
4. Remedy damage from use of insecticides.
5. Irrigating sufficient to saturate root system.
6. Pruning, including removal of dead or broken branches, and treatment of pruned areas or other wounds.
7. Disease control.
8. Maintaining wrapping, guys, and stakes. Repair or replace accessories when required.

PART 2 - PRODUCTS

2.1 TOPSOIL

A. Topsoil for landscape work is to be loamy sand from local pits.
   1. Sandy or Loamy Sand from well drained sites.
   2. Free from refuse, roots, heavy clay, stones larger than one-quarter inch in largest direction, gravel, sticks, brush, litter and other deleterious substances.
   3. Less than ten percent clay content and more than 75 percent sand content.
   4. Salinity - ECe no greater than four mmhos/cm.
   5. Water holding capacity between 40 percent and 55 percent.
   7. pH - Less than 8.5

B. On site soil, no particle size over 2 inch diameter.
   1. Sandy or Loamy Sand from well drained sites.
   2. Free from refuse, roots, heavy clay, stones larger than one-quarter inch in largest direction, gravel, sticks, brush, litter and other deleterious substances.
   3. Less than ten percent clay content and more than 75 percent sand content.
   4. Salinity - ECe no greater than four mmhos/cm.
   5. Water holding capacity between 40 percent and 55 percent.
   7. pH - Less than 8.5

2.2 SOIL AMENDMENTS

A. Fertilizer: FS O-F-241, Type I, Grade A; with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil as indicated in the soil analysis.

B. Organic soil conditioner: Gro-Power, Nutri-Mulch, Nevada Forest Products, Bio-Rem Or Equal: Submit under the provisions of Section 01600 for product substitutions.

C. Soil Sulphur: In quantities necessary to eliminate any deficiencies of topsoil as indicated in the soil analysis.

D. Iron Sulfate: In quantities necessary to eliminate any deficiencies of topsoil as indicated in the soil analysis or as shown on the soil mix details.

E. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of plants.

F. Herbicide: As needed.

G. Pesticide: As needed.

2.3 PLANT MATERIALS
A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work, grown in climatic conditions similar to those in locality of the work.

B. Ground Covers: Provide plants established and well rooted in removable containers or integral peat pots.

2.4 MISCELLANEOUS LANDSCAPE MATERIALS

A. Gravel Ground Cover: Water worn, hard, durable gravel, washed free of loam, sand, clay, and other foreign substances. Size, color and type as specified on the drawings.

B. Stakes and Guys: Provide stakes and deadmen of sound new hardwood, treated softwood, or redwood, free of knot holes and other defects. Provide wire ties and guys as shown on the planting details.

PART 3 - EXECUTION

3.1 PREPARATION

A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Owner’s Representative’s acceptance before start of planting work. Make minor adjustments as may be required.

3.2 PREPARATION OF PLANTING SOIL

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials over 2 inch diameter, and other materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

3.3 EXCAVATION FOR TREES AND SHRUBS

A. Excavate pits, beds, and trenches with sloped sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

B. Dispose of excess subsoil removed from planting excavations.

C. Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting. If water does not percolate in a 24 hour period a tree drainage chimney must be installed.

3.4 PLANTING TREES AND SHRUBS

A. Place plants for best appearance.

B. Set top of existing rootball flush with or slightly above finish grade.

C. Set plants vertical unless otherwise specified.
D. Remove non-biodegradable root containers.
E. Set plants in pits or beds, partially filled with prepared backfill mixture, at a minimum depth as indicated on drawings under each plant. Remove burlap, ropes, and wires from the root ball.
F. Saturate soil with water when the pit or bed is half full of topsoil and again when full.
G. Guy and stake trees immediately after planting, as indicated. Install stakes in pits prior to backfilling.

3.5 PLANTING GROUND COVER
A. Space ground cover plants as indicated or scheduled.
B. Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.

3.6 MISCELLANEOUS LANDSCAPE WORK
A. Install concrete mow curbs where indicated.
B. Place decomposed granite or crushed rock as specified under all trees and shrubs. Do not allow decomposed granite or crushed rock to pile against trunks of plants.

3.7 MAINTENANCE
A. Begin maintenance immediately after planting.
B. Maintain trees, shrubs, and other plants until final acceptance.
C. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Spray as required to keep trees and shrubs free of insects and disease.

3.8 CLEANUP AND PROTECTION
A. During landscape work, keep pavements clean and work area in an orderly condition.
B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.9 INSPECTION AND ACCEPTANCE
A. When landscape work is completed, including maintenance, Owner’s Representative will, upon request, make an inspection to determine acceptability.
   1. Landscape work may be inspected for acceptance in portions as agreeable to Owner’s Representative, provided each portion of work offered for inspection is complete, including maintenance.
B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Owner’s Representative and found to be acceptable. Remove rejected plants and materials promptly from project site.
END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

B. Cast-in-place site concrete including:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Concrete toppings.

C. Cast-in-place site concrete including curbs, gutters channels, pole bases and benches are included as Work of this Section.

1.2 RELATED REQUIREMENTS

A. Section 03351 - Concrete Floor Finishes, for finish requirements.

1.3 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

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

C. Mix Design:
   1. Submit proposed mix design of each class of concrete to the Engineer of Record for review prior to commencement of Work.
   2. All mix designs shall bear the project name and the location where the concrete mix is to be used.
   3. All mix designs shall bear the wet seal and signature of a Registered Professional Engineer licensed to practice in the State of Nevada.

D. Shop Drawings:
   1. Steel Reinforcement: Show details of fabrication, bending, and placement. Drawings shall be prepared according to ACI 315. Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement.
   2. Formwork: Prepared by, or under the supervision of, a qualified professional engineer licensed in the state of Nevada, detailing fabrication, assembly, and support of formwork. Drawings shall indicate dimensions, materials, bracing, and arrangement of joints and ties.
   3. Joints: Show proposed location of construction joints, expansion/contraction joints and control joints and obtain approval from Architect prior to construction.

1.4 QUALITY ASSURANCE:

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment with minimum ten (10) years of documented experience.
B. Installer: Company specializing in performing the work of this section with minimum five (5) years of documented experience.

C. ACI Publications: Comply with the following unless modified by the requirements in the Contract Documents:
   1. ACI 301, “Specification for Structural Concrete,” Sections 1 through 5.
   2. ACI 117, “Specifications for Tolerances for Concrete Construction and Materials”.
   3. ACI 315 - Details and Detailing of Concrete Reinforcement.
   5. ACI 347R – Guide to Formwork for Concrete.
   6. AWS D1.4 - Structural Welding Code, Reinforcing Steel.
   7. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   8. ASTM A185 – Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
   11. CRSI 63 - Recommended Practice for Placing Reinforcing Bars.
   12. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
   13. The General Notes on the Structural Drawings are to be considered included in this Specification.


E. Testing Agency Qualifications: An independent agency, acceptable to the University, qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 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.

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


H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

I. Continuous Inspection: Continuous Inspection of concrete work will be provided for all structural concrete.

J. Mix Designs: Mix Designs are required for all types and strengths of concrete.

1.5 DELIVERY, STORAGE AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Water Stops: Store water stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS:

A. Conform to ACI 301 and ACI 347R unless noted otherwise.

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

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

2.2 STEEL REINFORCEMENT:

A. Reinforcing Bars: Bars for reinforcement shall conform to “Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement”, ASTM A615, Grade 60.
   1. Grade 40 may be used where noted on Structural Drawings.
   2. Where reinforcing requires welding, furnish ASTM A706, Grade 60 bars:
   3. Bars shall be unpainted, uncoated, and free from rust, dirt and loose scale.

B. Plain-Steel Welded Wire Reinforcement: ASTM A185, plain, fabricated from as-drawn steel wire into flat sheets.


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

2.3 CONCRETE MATERIALS:

A. Cementitious Material: Portland Cement: ASTM C150, Type V.


C. Water: ASTM C94. All water shall be clean, potable and free of deleterious amounts of acids, alkalis, salts, oils, or organic substances.


E. Chemical Admixtures: Provide admixtures certified by the 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 C494, Type A.
   2. Retarding Admixture: ASTM C494, Type D.
   3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.4 VAPOR RETARDERS:

A. Plastic Vapor Retarder: ASTM E1745, Class A, not less than 15 mils thick. Include the manufacturer's recommended adhesive or pressure-sensitive joint tape.
   1. Maintain permeance of less than 0.01 Perms [grains/ (ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
   2. Approved Manufacturers:
   3. Acceptable Manufacturers:
      a. Raven Industries Vapor Block 15.

B. Substitutions: See Section 01630 - Product Substitutions.

2.5 CURING MATERIALS:

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

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

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, non-dissipating, certified by the curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear Curing and Sealing Compound VOC Compliant, 350 g/l, shall be a liquid type membrane-forming curing compound, complying with ASTM C1315, Type I, Class A, 25% solids content minimum.

2.6 RELATED MATERIALS:


B. Bonding Agent: Two component modified epoxy resin.

C. Non Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

D. Reglets: Fabricate reglets of not less than 0.0217-inch thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.7 CONCRETE MIXTURES:

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture, according to ACI 301.
1. The mix designs shall be submitted at least three weeks prior to placement.
2. Shall be prepared by an approved independent testing laboratory utilizing the ACI 211.1 Trial Batch method with at least three points batched and plotted on a curve showing water/cement ratio versus compressive or flexural strength.
3. Trial batches and design shall have been performed within 12 months of submittal.
4. Changes to approved mix designs or materials are not allowed without written approval of the Engineer.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by no more than 15 percent by weight.

C. Proportion normal-weight concrete mixture for foundations and misc. concrete shall be as follows:
   1. Minimum Compressive Strength: 4500 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45
   3. Slump Limit: 3 inches for before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.
   5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

D. Proportion normal-weight concrete mixture at interior slabs on grade as follows:
   1. Minimum Compressive Strength: 4500 psi at 28 days (6 sacks/cu. yard, minimum).
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 1 1/2 percent to 4 percent at point of delivery for 3/4 inch nominal maximum aggregate size.
   5. Synthetic Fiber: Uniformly disperse in the concrete mixture at the manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

2.8 FABRICATING REINFORCEMENT:

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

2.9 CONCRETE MIXING:

A. Ready-Mixed Concrete:
   1. Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.
   2. When air temperature is between 85° and 90° F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90° F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK:

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

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

C. Chamfer exterior corners and edges of permanently exposed concrete.
3.2 EMBEDDED ITEMS:

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

3.3 VAPOR RETARDERS:

A. Install vapor barrier in accordance ASTM E1643.
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
   2. Extend vapor barrier over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
   3. Seal vapor barrier to foundation wall, grade beam, or slab at an elevation consistent with the top of the slab or terminate at impediments such as waterstops or dowels.
   4. Overlap joints 6 inches and seal with manufacturer’s tape.
   5. Apply tape to a clean and dry vapor barrier.
   6. Seal all penetrations (including pipes) per manufacturer’s instructions.
   7. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
   8. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

3.4 STEEL REINFORCEMENT:

A. General:
   2. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, 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, where indicated.

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

E. 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.

3.5 JOINTS:

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

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

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

2. 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 tool marks on concrete surfaces.

3. 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.

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

3.6 CONCRETE PLACEMENT:

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

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness.

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.

C. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

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

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

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.

1) Maintain concrete temperature at or below 90 deg F at time of placement. Concrete with a temperature above 90 deg F will be rejected. 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. Smooth-Formed Finish:
1. As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
2. Repair and patch tie holes and defects.
3. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
4. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

B. Smooth Rubbed Finish:
1. Apply the following to smooth-formed finished as-cast concrete where indicated.
2. Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
3. Do not apply cement grout other than that created by the rubbing process.

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

3.8 FINISHING FLOORS AND SLABS:

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

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

C. 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.
1. While concrete is still plastic, slightly scarify surface with a fine broom.
2. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

D. Broom Finish: Apply a broom finish to exterior concrete.

3.9 CONCRETE PROTECTING AND CURING:

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

B. Evaporation Retarder:
1. 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.
2. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
C. 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.

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.

3. Curing Compound:
   a. Apply uniformly in continuous operation by power spray or roller according to manufacturer’s written instructions.
   b. Reccoat areas subjected to heavy rainfall within three hours after initial application.
   c. Maintain continuity of coating and repair damage during curing period.
   d. After curing period has elapsed, remove curing compound without damaging concrete surfaces by methods recommended by the curing compound manufacturer unless the manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

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

3.10 CONCRETE SURFACE REPAIRS:

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

B. Slab Curling: The Contractor shall take reasonable means to keep slab curling to a minimum. In the event that slab curling occurs that will be detrimental to the intended slab use and Architectural qualities needed for the final slab finish, the Contractor, at his expense, shall provide edge grinding or other means as necessary to bring the slab surface to a finish surface acceptable to the Engineer and Architect.

3.11 TOLERANCES:

A. Maximum variation of surface flatness for interior concrete slabs, exposed and covered, shall be 1/8" in 10 ft.

B. Maximum variation of surface flatness for exterior concrete slabs and walks shall be 1/4" in 10 ft.

3.12 FIELD QUALITY CONTROL:

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

B. Field inspection and testing will be performed in accordance with ACI 301 and ACI 318.

C. Provide free access to Work and cooperate with appointed firm.

D. Four (4) concrete test cylinders of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yards of concrete nor less than once for each 5,000 square feet of surface area.
E. One (1) additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

F. One (1) slump test will be taken for each set of test cylinders taken.

G. Provide for special inspection of concrete work where required by IBC.

END OF SECTION
SECTION 03351
CONCRETE FLOOR FINISHES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Surface treatments for concrete floors and slabs.
B. Surface treatment with concrete hardener and sealer.

1.2 RELATED REQUIREMENTS:

A. Section 03300 - Cast-in-Place Concrete: Curing compounds that also function as sealers.

1.3 REFERENCE STANDARDS:

B. ASTM C1315 Standard Specification for Liquid Membrane-Forming Compounds, having Special Properties for Curing and Sealing Concrete
C. AASHTO M 148 - Liquid Membrane Forming Compounds for Curing Concrete.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordinate the work with concrete floor placement and concrete floor curing.

1.5 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.
B. Product Data: Manufacturer’s published data on each finishing product, including information on compatibility of different products and limitations.
C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
D. Manufacturer’s Certification: Submit manufacturer’s ISO 9001/9002 certification.

1.6 QUALITY ASSURANCE:

A. Applicator Qualifications: Applicator must have prior experience applying specified product or similar products, or have manufacturer’s representative on site ensuring that preparation and application are performed correctly.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials in manufacturer's sealed packaging, including application instructions.
B. Store in cool dry area. Protect from freezing.

1.8 FIELD CONDITIONS:

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
B. Do not finish floors until interior heating system is operational.

C. Maintain ambient temperature of 50 degrees F minimum.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

1. L&M Construction Chemicals, Inc.; 14851 Calhoun Road, Omaha, NE 68152 800-362-3331; www.lmcc.com

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed. Submit as substitution according to Conditions of the Contract and Division 1 Sections.


C. Substitutions: See Section 01630 – Product Substitution.

2.2 PERFORMANCE:

A. Water-based acrylic curing and sealing compound shall be a non-yellowing, clear, acrylic curing and sealing compound meeting the following requirements:

1. ASTM C309, Type 1, Class B

2. AASHTO M148, Type 1, Class B.

3. ASTM C1315, Type I Class A, Section 6.4.1 - non-yellowing.

4. ASTM C1315, Section 6.6 - exceed 50 MPa (70 psi) adhesion requirements

5. ASTM D2047 slip-resistance requirements.

2.3 CONCRETE FLOOR FINISH APPLICATIONS:

A. Liquid Densifier/Hardener:

B. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.

1. Composition: Lithium silicate.

2. Products:


PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.2 GENERAL:

A. Apply materials in accordance with manufacturer's instructions.

3.3 SURFACE PREPARATION:

A. Protect adjacent surfaces not designated to receive curing and sealing compound.

B. Clean and prepare surfaces to receive curing and sealing compound in accordance with manufacturer's instructions.

C. Ensure concrete surface is clean and dry, with all stains, oil, grease, dust, and dirt removed.

D. Concrete surface water should be dissipated when used on new concrete.

E. Concrete surfaces should not be marred by walking workers.

3.4 APPLICATION:

A. Apply curing and sealing compound in accordance with manufacturer's instructions.

B. Ensure product is mixed for optimum performance. Avoid aggressive mixing as foaming may occur.

C. Use an industrial sprayer with a 5916 tip that produces a flow rate of 1/10 of one gallon per minute.

D. Alternatively apply using a lint-free roller or lamb's wool roller.

E. Avoid puddling in low areas.

3.5 FLOOR SEALER:

A. At areas indicated on Drawings, provide 2 coats of sealer.

B. Surface must be clean, dry and free of loose dirt, oil, wax, curing and parting compounds and other foreign matter.

C. Apply each coat in accordance with Manufacturer's printed instructions.

3.6 COATING APPLICATION:

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

D. Apply coatings in accordance with manufacturer’s instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

3.7 PROTECTION

A. Restrict foot traffic for at least four hours; 12 hours is preferable.

END OF SECTION
SECTION 04200
UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Concrete masonry units (CMU's).
B. Mortar and grout for masonry.
C. Reinforcement, anchorage, and accessories for masonry installation.
D. Integral water repellant admixture.

1.2 RELATED REQUIREMENTS:

A. Section 01453 - Code-Required Special Inspections:
B. Section 07620 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.

1.3 REFERENCES

A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
B. ACI 530.1 - Specifications for Masonry Structures.
F. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
I. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: Provide manufacturer’s specifications and engineering data on block units, reinforcing and accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109 or C780 for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.
   2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Manufacturer’s Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

E. Samples: Submit five (5) samples of masonry units to illustrate color, texture and extremes of color range.

1.5 QUALITY ASSURANCE:

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

B. Manufacturer: Company specializing in performing the work of this section with minimum ten (10) years of documented experience.

C. Installer: Company specializing in performing the work of this section with minimum five (5) years of documented experience.

D. Fire Performance Characteristics: For fire rated construction, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E119 by a testing and inspecting organization such as UL, by equivalent concrete masonry thickness, or by another having jurisdiction.

E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

1.6 PRE INSTALLATION CONFERENCE:

A. Refer to Section 01300 – Administrative Requirements for additional information regarding Project Meetings.

B. Convene after completion of mock-up panel and at least one week prior to commencing work of this Section

C. Provide two weeks written notice of time and date of meeting to Owner and Architect.

D. Review layout, materials, reinforcing and grouting procedures and any special conditions required to complete work.
E. The following personnel are required to be in attendance:
   1. General Contractor’s Superintendent.
   2. Prime Subcontractors involved including subcontractors providing items to be installed or grouted in during masonry work and those providing work adjacent to masonry.
   3. Owner and Architects representative.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements:
   1. Do not use frozen materials or materials mixed or coated with ice or frost.
   2. Do not build on frozen substrates.
   3. Remove and replace unit masonry damaged by frost or by freezing conditions.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. Field Measurements:
   1. Verify measurements shown on Drawings by taking field measurements.
   2. Proper fit and attachment of concrete masonry units is required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS   CONCRETE MASONRY UNITS

A. Cinderlite.

B. Superlite Block.

C. Rinker Materials.

D. Trenwthy.

E. Substitutions: Refer to Section 01630 – Product Substitutions for substitution requirements.

2.2 CONCRETE MASONRY UNITS:

A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. CMU: ASTM C90, Grade 1.

C. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2500 psi.

D. Provide texture, shape and color as directed and approved by the Architect.

E. Standard grey units may be used where they are totally concealed from view.

F. See the Architectural drawings for the layup pattern and mortar joint locations.

G. Density Classification: Medium weight, unless otherwise indicated.
H. All exterior block shall contain an integral water-repellant admixture. Provide in accordance with admixture manufacturer's instructions. Approved admixture manufacturers are:
1. W.R. Grace & Co. “Dry Block”
2. Krete Industries “HQ Plus”

2.3 CONCRETE AND MASONRY LINTELS:
A. General: Provide one of the following:
B. MasonryLintels: Prefabricated with reinforcing bars placed as indicated and filled with coarse grout.

2.4 MORTAR AND GROUT MATERIALS:
A. Portland Cement: ASTM C150, Type II. Provide natural color or white cement as required to produce the mortar color indicated.
B. Hydrated Lime: ASTM C207, Type S.
C. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
D. Aggregate for Mortar: ASTM C144.
   1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
E. Aggregate for Grout: ASTM C404.
F. All exterior block mortar and grout shall contain an integral water-repellant admixture. Provide in accordance with admixture manufacturer's instructions. Approved admixture manufacturers are:
   1. W.R. Grace & Co. “Dry Block”
   2. Krete Industries “HQ Plus”
G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494, Type C, and recommended by the manufacturer for use in masonry mortar of the composition indicated.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Euclid Chemical Company (The); Accelguard 80.
      c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
H. Water: Potable.

2.5 REINFORCEMENT:
A. Reinforcing Steel: ASTM A615, 60 ksi yield grade, deformed billet steel bars. Contractor may use 40 ksi where allowed by Structural Drawings.
B. Joint Reinforcing: Galvanized steel wire as noted on structural drawings. Provide stainless steel where required by code.

2.6 TIES AND ANCHORS:
A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008, Commercial Steel, with ASTM A153, Class B coating.

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

C. Partition Top anchors: 0.105 inch thick metal plate with 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

E. Anchor Bolts: Headed steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A153, Class C; of dimensions indicated.

2.7 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. Use Portland cement-lime mortar, unless otherwise indicated.
3. For exterior masonry, use Portland cement-lime mortar.
4. For reinforced masonry, use Portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
6. Provide integral water-repellant admixture specified above. Provide in accordance with manufacturer's instructions.

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 Unit Masonry: Shall conform to ASTM C270 and IBC requirements. 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 with a 28-day compressive strength of 1800 psi.
2. For reinforced masonry, use Type S with a 28-day compressive strength of 1800 psi.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S with a 28-day compressive strength of 1800 psi.

D. Grout for Unit Masonry: Comply with IBC requirements.

1. Use course grout that will comply with Table 1.15.1 in ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143.
2.8 FLASHINGS
A. Metal Flashing Materials: Galvanized Steel, as specified in Section 07 62 00.

2.9 ACCESSORIES
A. Control Joints and Filler: Rubber material. Provide with corner and tee accessories, fused joints. See Structural Drawings for requirements.
C. Weeps: Polyethylene tubing.
D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 - EXECUTION
3.1 INSTALLATION, GENERAL:
A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

3.2 PREPARATION:
A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 LAYING MASONRY WALLS:
A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
B. Bond Pattern for Exposed Masonry: 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.
C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
3.4 MORTAR BEDDING AND JOINTING:

A. Lay CMU 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 in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 REINFORCED UNIT MASONRY INSTALLATION:

A. Temporary Formwork and Shores:
   1. Construct formwork and shores as needed to support reinforced masonry elements during construction.
   2. 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.
   3. 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 ACI 530.1/ASCE 6/TMS 602.

C. Grouting:
   1. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure (24 hours minimum).
   2. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   3. Limit height of vertical grout pours to not more than 60 inches.

3.6 CONTROL AND EXPANSION JOINTS:

A. Install control and expansion joints at the following maximum spacings, unless otherwise indicated on Drawings:
   1. Exterior Walls: 20 feet on center and within 24 inches on one side of each interior and exterior corner.
   2. Interior Walls: 30 feet on center.
   3. At changes in wall height.

B. Do not continue horizontal joint reinforcement through control and expansion joints unless shown otherwise on drawings.

C. Install preformed control joint device in continuous lengths. Seal butt and corner joints.

D. Form expansion joint by omitting mortar and cutting unit to form open space.
3.7 TOLERANCES:

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation: Plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan: Plus or minus 1/2 inch.
   3. For location of elements in elevation: Plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls, 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals: 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces: 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints: 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces: 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:
   1. For bed joints: Plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For head and collar joints: Plus 3/8 inch or minus 1/4 inch.
   3. For exposed head joints: Plus or minus 1/8 inch.

3.8 FIELD QUALITY CONTROL:

A. Testing and Inspecting:
   1. Owner will engage a special inspection and testing agency to perform tests and inspections and prepare reports.
   2. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections.
   3. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the IBC.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
3.9 REPAIRING, POINTING, AND CLEANING:

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
   2. Protect surfaces from contact with cleaner.
   3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   4. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to the type of stain on exposed surfaces.

END OF SECTION
SECTION 05310
STEEL DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Roof deck.

B. Non-composite form deck

C. Bearing plates and angles.

D. Acoustical insulation in roof deck flutes.

1.2 RELATED REQUIREMENTS:

A. Section 01400 - Quality Requirements.

B. Section 01453 - Code-Required Special Inspections.

C. Section 05120 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.

D. Section 05120 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.

E. Section 05500 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.3 REFERENCE STANDARDS:


F. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2011 w/Errata.


I. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.
1.4 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittals requirements.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, cellular raceways and outlet box locations, pertinent details, and accessories. Note deck welding pattern and physical properties of decking.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

H. Report: Submit ICBO report showing diaphragm shear test.

1.5 QUALITY ASSURANCE:

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Nevada.


C. Certifications:
   1. Prior to fabrication or shipment of material to the job site, furnish certification of the manufacturer of the steel decking that material furnished meets or exceeds requirements of ASTM standards specified or noted on Drawings, for each type of
1. Prior to site welding operation, submit welders' written certifications and qualifications.

D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172) with minimum ten (10) years of documented experience.

E. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Steel Deck:

B. Substitutions: See Section 01630 – Product Substitutions.

2.2 STEEL DECK:

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual, unless noted on Structural Drawings.
   1. Calculate to structural working stress design and structural properties specified.
   5. Maximum Lateral Deflection of Diaphragms: 1/500 of the height of the wall.

B. Ribbed Deck and Accessories
   1. Steel: ASTM A1008, Grade C, having a minimum yield strength of 38 ksi, or as required by structural design.
      a. Finish:
         1) Phosphatized and prime painted; galvanized where fire-proofed to comply with ASTM A653, Grade G-60.
   2. Provide ridge and valley plates, closures, cant strips, roof sump pans and other accessories of same material and finish as steel deck.
   3. Furnish miscellaneous supporting members at openings and edges, as shown on Drawings and as required.

C. Roof Deck: Non-composite type, fluted steel sheet:
   1. Deck Type and Thickness: Refer to Structural Drawings.
      a. Grade as required to meet performance criteria.
   2. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
   3. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
4. Minimum Base Metal Thickness: 18 gage, 0.0359 inch.
5. Nominal Height: 1-1/2 inch.
6. Profile: Fluted; Verco HS36 or approved equal.
7. Formed Sheet Width: 24 inch.
8. Side Joints: Lapped, welded or fasteners in accordance with Structural Drawings.
9. End Joints: Lapped, welded or fasteners in accordance with Structural Drawings.
10. Fire Resistance Classification: Comply with UL Assembly Number required for the specified assemblies.

D. Non-Composite Steel Form: Sheet steel for galvanized deck shall conform to ASTM A653 (A653M) Structural Quality, with a minimum yield strength of 33 ksi (230 MPa).

1. Deck Type and Thickness: Refer to Structural Drawings.
2. Accessories
   a. Pour stops, column closures, end closures, cover plates, and girder.
   1) Fillers shall be the type required by the Steel Deck Institute.
   b. Mechanical fasteners or welds are acceptable for accessory attachments.

2.3 ACCESSORY MATERIALS:

A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
B. Welding Materials: AWS D1.1/D1.1M.
C. Fasteners: Galvanized hardened steel, self-tapping.
D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.
      a. Hardness: Rockwell C 54.5, minimum.
      b. Tensile Strength: 285 kips per square inch, minimum.
      c. Shear Strength: 175 kips per square inch, minimum.
      d. Washers:
         1) Steel Bar Joist Framing Applications: 0.472 inch diameter, minimum.
         2) Exposed Roof Deck Applications: 0.591 inch diameter, minimum.
      e. Corrosion Resistance:
         1) Steel Bar Joist Framing Applications: ASTM B633, SC1, Type III zinc electroplate.
         2) Exposed Roof Deck Applications: Provide manufacturer's standard stainless steel sealing caps with bonded neoprene washer over each fastener.
E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
   1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.
   2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B 633, SC1, Type III zinc electroplate.
   3. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.
F. Mechanical Sidelap Connectors: Steel; hex washer head undercut with reverse serrations and self-piercing or stitch point at center.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications.
   a. Hardness: Vickers Surface Hardness 450 HV0.3, minimum.
   b. Corrosion Resistance:
      1) Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B633, SC1, Type III zinc electroplate.
      2) Fasteners for Exposed Steel Roof Deck Application: Manufacturer’s standard stainless steel with bonded neoprene washer.

G. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

J. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

K. Acoustical Insulation: Glass fiber type, minimum 1.1 lb. /cu ft. density; profiled to suit deck.

2.4 FABRICATED DECK ACCESSORIES:

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.

B. Cant Strips: Formed sheet steel, 22 gage, 0.0299 inch minimum thickness, 45 degree slope, 3-1/2 inch nominal width and height, flange for attachment.

C. Roof Sump Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

D. Floor Drain Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION:

A. Erect metal deck in accordance with SDI Design Manual and manufacturer’s instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified, unless noted on Structural Drawings.
   1. Welding: Use fusion welds through weld washers.
2. Place and secure special deep fluted sections for integral concrete bridging.

E. Clinch lock seam side laps.

F. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.

G. Drive mechanical sidetop connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

H. At welded male/female side laps weld at 18 inches on center maximum.

I. Weld deck in accordance with AWS D1.3/D1.3M or install fasteners in accordance with Structural Drawings and manufacturer requirements.

J. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

K. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

L. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

M. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

N. Openings cut by the deck erector. Openings not shown on the erection diagram shall be cut and reinforced if necessary, by the Trade requiring the openings.

O. Ridge and valley plates, closures, cant strips, roof sump pans and other accessories shall be attached directly to the deck.

P. Place metal cant strips in position and fusion weld.

Q. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

R. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

S. Weld stud shear connectors through steel deck to structural members below.

T. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

3.3 FIELD QUALITY CONTROL:

A. Tests: When required by the Architect or Engineer of Record, installation of metal decking and welding shall be subject to inspection by a qualified Testing Agency acceptable to Architect and Engineer of Record.

END OF SECTION
SECTION 05310
STEEL DECKING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Roof deck.

B. Non-composite form deck

C. Bearing plates and angles.

D. Acoustical insulation in roof deck flutes.

1.2 RELATED REQUIREMENTS:

A. Section 01400 - Quality Requirements.

B. Section 01453 - Code-Required Special Inspections.

C. Section 05120 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.

D. Section 05120 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.

E. Section 05500 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.3 REFERENCE STANDARDS:


F. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2011 w/Errata.


I. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2006.


O. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2007.


1.4 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittals requirements.

B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, cellular raceways and outlet box locations, pertinent details, and accessories Note deck welding pattern and physical properties of decking.

C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.

D. Certificates: Certify that products furnished meet or exceed specified requirements.

E. Submit manufacturer's installation instructions.

F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

H. Report: Submit ICBO report showing diaphragm shear test.

1.5 QUALITY ASSURANCE:

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Nevada.


C. Certifications:
   1. Prior to fabrication or shipment of material to the job site, furnish certification of the manufacturer of the steel decking that material furnished meets or exceeds requirements of ASTM standards specified or noted on Drawings, for each type of material.
   2. Prior to site welding operation, submit welders' written certifications and qualifications.
D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172) with minimum ten (10) years of documented experience.

E. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Cut plastic wrap to encourage ventilation.

B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Steel Deck:
   1. Canam Steel Corporation: www.canam-construction.com

B. Substitutions: See Section 01630 – Product Substitutions.

2.2 STEEL DECK:

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual, unless noted on Structural Drawings.
   1. Calculate to structural working stress design and structural properties specified.
   5. Maximum Lateral Deflection of Diaphragms: 1/500 of the height of the wall.

B. Ribbed Deck and Accessories
   1. Steel: ASTM A1008, Grade C, having a minimum yield strength of 38 ksi, or as required by structural design.
      a. Finish:
         1) Phosphatized and prime painted; galvanized where fire-proofed to comply with ASTM A653, Grade G-60.
   2. Provide ridge and valley plates, closures, cant strips, roof sump pans and other accessories of same material and finish as steel deck.
   3. Furnish miscellaneous supporting members at openings and edges, as shown on Drawings and as required.

C. Roof Deck: Non-composite type, fluted steel sheet:
   1. Deck Type and Thickness: Refer to Structural Drawings.
      a. Grade as required to meet performance criteria.
   2. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
   3. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
   4. Minimum Base Metal Thickness: 18 gage, 0.0359 inch.
   5. Nominal Height: 1-1/2 inch.
   6. Profile: Fluted; Verco HSB36 or approved equal.
7. Formed Sheet Width: 24 inch.
8. Side Joints: Lapped, welded or fasteners in accordance with Structural Drawings.
9. End Joints: Lapped, welded or fasteners in accordance with Structural Drawings.
10. Fire Resistance Classification: Comply with UL Assembly Number required for the specified assemblies.

D. Non-Composite Steel Form: Sheet steel for galvanized deck shall conform to ASTM A653 (A653M) Structural Quality, with a minimum yield strength of 33 ksi (230 MPa).

1. Deck Type and Thickness: Refer to Structural Drawings.
2. Accessories
   a. Pour stops, column closures, end closures, cover plates, and girder.
      1) Fillers shall be the type required by the Steel Deck Institute.
   b. Mechanical fasteners or welds are acceptable for accessory attachments.

2.3 ACCESSORY MATERIALS:

A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.

B. Welding Materials: AWS D1.1/D1.1M.

C. Fasteners: Galvanized hardened steel, self-tapping.

D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point.
   Comply with applicable requirements of ICC-ES AC70.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.
      a. Hardness: Rockwell C 54.5, minimum.
      b. Tensile Strength: 285 kips per square inch, minimum.
      c. Shear Strength: 175 kips per square inch, minimum.
      d. Washers:
         1) Steel Bar Joist Framing Applications: 0.472 inch diameter, minimum.
         2) Exposed Roof Deck Applications: 0.591 inch diameter, minimum.
   e. Corrosion Resistance:
      1) Steel Bar Joist Framing Applications: ASTM B633, SC1, Type III zinc electroplate.
      2) Exposed Roof Deck Applications: Provide manufacturer's standard stainless steel sealing caps with bonded neoprene washer over each fastener.

E. Mechanical Fasteners: Steel; hex washer head, self-drilling, self-tapping.
   1. Design Requirements for Sidelap Connections: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications and ICC-ES AC43.
   2. Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B 633, SC1, Type III zinc electroplate.
   3. Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.

F. Mechanical Sidelap Connectors: Steel; hex washer head undercut with reverse serrations and self-piercing or stitch point at center.
   1. Design Requirements: Provide number and type of fasteners that comply with the applicable requirements of SDI design method for roof deck and floor deck applications.
      a. Hardness: Vickers Surface Hardness 450 HV0.3, minimum.
      b. Corrosion Resistance:
1) Fasteners for Steel Roof Decks Protected with Waterproofing Membrane: ASTM B 633, SC1, Type III zinc electroplate.

2) Fasteners for Exposed Steel Roof Deck Application: Manufacturer's standard stainless steel with bonded neoprene washer.

G. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

J. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

K. Acoustical Insulation: Glass fiber type, minimum 1.1 lb./cu ft. density; profiled to suit deck.

2.4 FABRICATED DECK ACCESSORIES:

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.

B. Cant Strips: Formed sheet steel, 22 gage, 0.0299 inch minimum thickness, 45 degree slope, 3 1/2 inch nominal width and height, flange for attachment.

C. Roof Sump Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.

D. Floor Drain Pans: Formed sheet steel, 14 gage, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION:

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1-1/2 inch bearing.

D. Fasten deck to steel support members at ends and intermediate supports at 12 inches on center maximum, parallel with the deck flute and at each transverse flute using methods specified, unless noted on Structural Drawings.

   1. Welding: Use fusion welds through weld washers.
   2. Place and secure special deep fluted sections for integral concrete bridging.

E. Clinch lock seam side laps.
F. At mechanically fastened male/female side laps fasten at 24 inches on center maximum.

G. Drive mechanical sidelap connectors completely through adjacent lapped sheets; positively engage adjacent sheets with minimum three-thread penetration.

H. At welded male/female side laps weld at 18 inches on center maximum.

I. Weld deck in accordance with AWS D1.3/D1.3M or install fasteners in accordance with Structural Drawings and manufacturer requirements.

J. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.

K. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.

L. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

M. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

N. Openings cut by the deck erector. Openings not shown on the erection diagram shall be cut and reinforced if necessary, by the Trade requiring the openings.

O. Ridge and valley plates, closures, cant strips, roof sump pans and other accessories shall be attached directly to the deck.

P. Place metal cant strips in position and fusion weld.

Q. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

R. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

S. Weld stud shear connectors through steel deck to structural members below.

T. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

3.3 FIELD QUALITY CONTROL:

A. Tests: When required by the Architect or Engineer of Record, installation of metal decking and welding shall be subject to inspection by a qualified Testing Agency acceptable to Architect and Engineer of Record.

END OF SECTION
SECTION 05400
COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Interior structural stud framing at soffit ceiling where:
   1. Load is greater than 20 psf transverse.
   2. Load is greater than 200 lbs. axial.

1.2 RELATED REQUIREMENTS:

A. Section 05500 - Metal Fabrications, for masonry shelf angles and connections.
B. Section 09260 - Gypsum Board Shaft-Wall Assemblies for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 REFERENCE STANDARDS:

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
F. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2011c.
H. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2011 w/Errata.
K. Steel Stud Manufacturers Association (SSMA).
L. Steel Framing Industry Association (SFIA).
1.4 PREINSTALLATION MEETINGS

A. Refer also to Section 01300 – Administrative Requirements.

B. Preinstallation Conference: Conduct conference at Project site.

C. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.5 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: For each type of cold-formed steel framing product and accessory.
   1. Product Test Reports: For each listed product, for tests performed a qualified testing agency.
      a. Steel sheet.
      b. Expansion anchors.
      c. Power-actuated anchors.
      d. Mechanical fasteners.
      e. Vertical deflection clips.
      f. Horizontal drift deflection clips
      g. Miscellaneous structural clips and accessories.

C. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated-Design Submittal: For cold-formed steel framing.

E. Qualification Data:
   1. For testing agency.
   2. Welding certificates.

F. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum ten (10) years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by manufacturer.

C. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
F. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Furnish products as Manufactured by a Manufacturing member of the Steel Stud Manufacturers Association (SSMA) www.ssma.com, or Steel Framing Industry Association (SFIA) and subject to compliance with Specification requirements.

B. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

1. Metal Framing:

C. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.


D. Framing Connectors and Accessories:

1. Same manufacturer as metal framing.

2.2 PERFORMANCE REQUIREMENTS:

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 - Quality Requirements, design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 8.5 lbf/sq. ft.
   b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope 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 (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of 1/2 inch (13 mm).
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:
2. Wall Studs: AISI S211.
3. Headers: AISI S212.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E119; 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.

2.3 COLD-FORMED STEEL FRAMING, GENERAL:

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

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
2. Coating: G60 (Z180) or equivalent.

C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: 33 (230), 50 (340), or as required by structural performance.
2. Coating: G60 (Z180) or G90 (Z275).

2.4 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: As indicated.
2. Flange Width: As indicated.
3. Section Properties: 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: As indicated.
2. Flange Width: As indicated.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: As indicated.
3. Section Properties: <Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment>.

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
1. Minimum Base-Metal Thickness: As indicated.
2. Top Flange Width: As indicated.
3. Section Properties: As indicated.
2.5 CEILING JOIST FRAMING:

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: As indicated.
   2. Flange Width: As indicated.
   3. Section Properties: As indicated.

2.6 FRAMING ACCESSORIES:

A. Fabricate steel-framing accessories from steel sheet, ASTM A1003/A1003M, 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.
   9. Joist hangers and end closures.

2.7 ANCHORS, CLIPS, AND FASTENERS:

A. Steel Shapes and Clips: ASTM A36/A 6M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS:

A. Galvanizing Repair Paint: As indicated.

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/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION:

A. Fabricate cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M 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 no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, 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 (1:960) and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

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 of the Work.

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

3.2 PREPARATION:

A. Before sprayed fire-resistant materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistant 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 load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL:

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 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 (1.6 mm).

D. Install cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M 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 joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 07210 “Building 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 approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) 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 indicated.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) 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 nonplumb 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 according to AISI S200, Section C1. 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 vertically as indicated. Fasten at each stud intersection.
   1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) 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 JOIST INSTALLATION:

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 3 inches.
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated.
   1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
   1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
   2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

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.
3.7 REPAIRS AND PROTECTION:

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780 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 steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Shop fabricated steel, aluminum, and miscellaneous metal items.

B. Metal fabrications, including items fabricated from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems in other Sections of these Specifications.

C. Miscellaneous framing and supports including, but not limited to the following:
   1. Carpenter's ironwork.
   2. Bent bar or angle frame countertop supports and backing plates.
   3. Applications where framing and supports are not specified in other sections.
   4. Frames for glass and decorative plastic glazing.
   5. Hangers & Supports per Mechanical, Plumbing & Electrical Drawings.

D. Supports for suspended ceilings, suspended finishes, chandeliers and fixtures and other items as necessary.

E. Slotted channel framing system used for support of the following:
   1. Ceilings and soffits as noted.
   2. Structural applications as noted.
   3. Hangers & Supports per Mechanical, Plumbing & Electrical Drawings.

F. Ladders:
   1. Roof Ladder

G. Bollards.

H. Other items as indicated in Drawings.

1.2 RELATED REQUIREMENTS:

A. Section 03300 - Cast-In-Place Concrete: Execution requirements for embedded anchors and attachments for metal fabrications specified by this section in concrete.

B. Section 04200 - Unit Masonry: Execution requirements for embedded anchors and Attachments for metal fabrications specified by this section in masonry.

C. Section 05120 - Structural Steel Framing: Structural steel column anchor bolts.

D. Section 05310 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.

E. Section 09900 – Painting and coatings: Paint finish.

1.3 REFERENCE STANDARDS:


N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.

O. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2011 w/Errata.


R. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).


T. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.4 SYSTEM DESCRIPTION FOR SLOTTED CHANNEL FRAMING SYSTEM:

A. Slotted channel framing system is a performance specification and the slotted channel framing supplier shall be responsible for structural design and engineering required to meet specified performance requirements within physical and aesthetic requirements established.
B. Contract Documents are an outline of criteria and performance requirements for the System. Requirements specified or indicated by details are intended to establish aesthetic design requirements and performance of interior finish materials.

C. Drawings do not necessarily indicate or describe total work required for completion of Work. Furnish and install all items required for complete installation.

D. Dimensions and profile adjustments may be made in proposed structural design in interest of fabrication or erection methods and techniques, or ability of design to satisfy design and performance requirements, provided that aesthetic design intent and intent of Contract Documents are maintained. Include modifications or additions required to meet specified requirements and maintain the visual design concept.

1.5 PERFORMANCE REQUIREMENTS FOR SLOTTED CHANNEL FRAMING SYSTEM:

A. Design Requirements: Design structural members in accordance with the following:
   1. Design system in accordance with the following Standards:
      a. Federal, State and Local Codes.
      d. Metal Framing Manufacturer's Association (MFMA).
   2. Design system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature changes.
   3. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
      a. Construction Tolerances: Plus or minus 1/2 inch minimum (all directions).
      b. Live load deflection of building structural elements: 1 inch minimum (to be confirmed by Engineer of Record).
   4. Engineering Responsibility: Slotted channel framing manufacturer shall assume undivided responsibility for engineering slotted channel framing system by employing a qualified professional engineer to prepare and seal design calculations, shop drawings, and other structural data. Engineer to be licensed in the State of Nevada.

B. Structural Performance: Design, engineer, fabricate, and erect structural slotted channel framing system to be capable of withstanding the effects of normal thermal movement, loads resulting from gravity and maintain stresses within the allowable limits and under conditions indicated:
   1. Gravity Loads: The slotted channel framing system and its anchorage or related components shall be designed with adequate strength and stiffness to accommodate the loads calculated for the wall framing elements and all cladding systems supported by the framing and/or transferring loads to the framing systems.

C. Design elements of the structural slotted channel framing systems to resist the applicable design loads and maintain the following allowable limits:
   1. Maximum allowable deflection:
      a. Perpendicular to the plane of a soffit, net deflection of framing members shall not exceed L/600 times the span, or 1/4 inch, whichever is less, using the dead load combined with wind load forces. Span is defined as the distance between anchor centerline.
      2. At connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to anchor, shall not exceed 1/16 inch in any direction.
3. At 1.5 times the design pressure loads for metal members, the net permanent deflection of framing members shall not exceed 1/1000 times span. There shall be no failure or gross permanent distortion of framing members, anchors or connections. At connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to anchor, shall not exceed 1/16 inch set after load is removed.

D. Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening or fracturing of attachments or components of system are not permitted in the installed work.

E. Design and analysis of bolted assemblies or fasteners to connect thin walled members shall use washers to avoid pull-over and tearing effects of the steel. Safety Factors shall be as required per Table A5.1 of AISI Commentary on the Cold Formed Specification.

F. Framing elements of the structural slotted channel framing system shall be so designed to accept and support concentrated loads that may be imposed by the adjacent cladding systems or other framing elements without exceeding performance criteria specified herein. To this end, the contractor performing this scope of work shall obtain all necessary engineering analysis including the relevant projected reaction loading data and make such provision in the structural metal stud system work as may be necessary.

1.6 PERFORMANCE REQUIREMENTS:

A. Counter Tops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
   1. All dead-loads.
   2. 500 pound live load placed on the countertop and vanity.
   3. Deflection at Midspan: L/500 times span or 1/8" whichever is less.

1.7 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Structural Calculations by a Registered Professional or Structural Engineer in the State of Nevada for approval by Engineer of Record.

C. Shop Drawings and Product Data for Slotted Channel Framing System: Include the following:
   1. Structural Calculations by a Registered Professional or Structural Engineer in the State of Nevada for approval by Engineer of Record. Calculations may include, but are not limited to:
      a. Description of design criteria.
      b. Stress of deflection analysis.
      c. Selection of framing members, fittings and accessories.
   2. Assembly drawings necessary to install the slotted channel framing system in compliance with the Contract Drawings.
   3. Pertinent manufacturers published data.

D. Welders’ Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
E. Fabricator’s Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.8 QUALITY ASSURANCE

A. Design shall be under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Nevada.

B. Standards: Comply with the following, except as otherwise shown and specified:
   1. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings."
   2. AISI "Specifications for the Design of Cold-Formed Steel Structural Members."
   3. AWS "Structural Welding Code-Steel."
   4. ASTM A6 "General Requirements for Rolled Steel Plates Shapes, Sheet Piping and Bars for Structural Use."

C. Qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."

D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel (AC172).

1.9 COORDINATION:

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.10 DELIVERY, STORAGE AND HANDLING

A. Exercise care during unloading, storage and erection to avoid damage. Support material stored at the site completely free of the ground, and cover to avoid damage from the elements.

1.11 PROJECT/SITE CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication, where possible, to ensure proper fitting of the Work. Allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the Work.

B. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL:

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed Pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 MATERIALS - STEEL

A. Steel Sections: ASTM A 6/A36M.
B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283.


E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
   1. Slotted Channel Fittings: ASTM A1011/A1011M.

F. Diamond Pattern Structural Steel Plate: ASTM A611 or ASTM A570, Grade B with diamond checker pattern.


H. Cold-Finished Carbon Steel Bars: ASTM A108, Grade as selected by fabricator.

I. Cold-rolled Carbon Steel Sheets: ASTM A611.

J. Cold-drawn Steel Tubing: ASTM A512, sunk drawn, butt welded, cold-finished and stress-relieved.

K. Fasteners: Provide zinc-coated fasteners with galvanizing complying with ASTM A153 for exterior use or where built into exterior walls.
   1. Bolts and nuts: ASTM A307, Grade A, regular hexagon head, ASTM A563; and, where indicated, flat washers.
   4. Lag bolts: Square head type. ASME B18.2.1
   7. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1
   8. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

L. Drilled-in Expansion Anchors: Expansion Anchors Complying with FS FF S 325, Group VIII (anchors, expansion), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF BS75, Grade 5.

M. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E488, conducted by a qualified independent testing agency.
   1. Interior Use - Material: Carbon-steel components zinc-plated to comply with ASTM B633, Class Fe/Zn 5.
   2. Exterior - Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F593 and nuts complying with ASTM F594.

N. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

O. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

P. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
2.3 MATERIALS – ALUMINUM:
A. Aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a coat of bituminous paint, Mylar isolators or other approved material.
B. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
C. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
F. Bolts, Nuts, and Washers: Stainless steel.
G. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.4 FABRICATION:
A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by intermittent welds and plastic filler.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.5 FABRICATED ITEMS:
A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
   1. Steel pipe, concrete filled, crowned cap, Schedule 40 steel pipe, 4 inches diameter, length as indicated on Drawings; galvanized.
   2. Size bollards to provide minimum 3 foot embedment.
   3. Concrete Fill: 3,000 psi as specified in Section 03300.
   4. Anchors: Concealed type as indicated on Drawings.
   5. Finish: Prime paint finish.
B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
C. Lintels: As detailed; prime paint finish.
D. Miscellaneous Framing and Supports:
   1. Provide miscellaneous steel framing and supports which are not a part of the structural steel framework, or other metal systems in other Sections of these Specifications, whether indicated or not as necessary to complete Work.
2. Fabricate miscellaneous units to sizes, shapes and profiles shown, or if not shown, of the dimensions required to receive adjacent grating, plates, doors or other Work to be retained by the framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars of all welded construction using mitered corners, welded brackets and splice plates, and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the Work.

3. Equip units with integrally welded anchor straps for casting into concrete or building into masonry wherever possible. Furnish inserts if units must be installed after concrete is poured. Except as otherwise shown, space anchors 24 inches o.c., and provide minimum anchor units of 1-1/4 inch x 1/3 inch x 8 inch steel straps.

E. Metal Ladders:
1. General: Fabricate ladders for the locations shown, with dimensions, spacings, and anchorages as indicated. Comply with requirements of ANSI A14.3.
   a. For elevator pit ladders, comply with ASME A17.1.
2. Siderails: Continuous, steel, 1/2" x 2-1/2" flat bars, with eased edges, space 18" apart.
4. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
5. Support each ladder at top and bottom and at intermediate points space not more than 5' o.c. with welded or bolted steel brackets.
6. Provide nonslip surfaces on top of each rung, either by coating the rung with aluminum-oxide granules set in epoxy-resin adhesive, or by using a type of manufacture rung that is filled with aluminum-oxide grout.
7. Provide ladder safety cages where required by local codes, to comply with ANSI A14.3.

F. Frames for Glass and Decorative Plastic Glazing: Steel frame fabricated to sizes and shapes indicated using steel tubing and shapes with extruded aluminum caps for sawtooth wall support for glass and decorative plastic glazing as indicated on Drawings.

G. Countertop Supports: Fabricate countertop supports from steel tube and shapes as detailed on Drawings. Continuously weld all joints and grind smooth where exposed.

H. Prevent galvanic action and other forms of corrosion by insulating contact points between metals and incompatible metals or materials. Provide separation of resilient gasket or other appropriate material to separate aluminum bar gratings and angles where units are attached.

2.6 SLOTTED CHANNEL FRAMING:

A. Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
   1. Basis of Design: Slotted Channel Framing System (Unistrut System): 1-5/8 inch by 1-5/8 inch slotted channel framing system, or as approved. Galvanized G90, cold formed metal channels with flange edges returned toward web with 9/16 inch wide slotted holes in webs at 2 inches o.c.
   2. Provide Manufacturer’s standard connectors, fasteners and other miscellaneous accessories as required for a complete installation and connection to supporting structure.
   3. All channel members shall be fabricated from structural grade steel conforming to one of the following ASTM specifications: A 1011 SS GR33 or A 653 GR33.
   4. All fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A 757, A 576, A 36 or A635.

B. Acceptable Manufacturer:
2.7 FINISHES – STEEL:

A. Prime paint steel items.
   1. Exceptions: Galvanize items to be embedded in concrete or masonry.
   2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements.

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.8 FINISHES – ALUMINUM:

A. Interior Aluminum Surfaces: Class I natural anodized.

B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

C. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick; light bronze.

D. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as scheduled.

E. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.9 FABRICATION TOLERANCES:

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION:

A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION – GENERAL:

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Install items plumb and level, accurately fitted, free from distortion or defects.

D. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

E. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   5. Perform field welding in accordance with AWS D1.1/D1.1M.

F. Obtain approval prior to site cutting or making adjustments not scheduled.

G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings, if any.

B. Anchor supports securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated at girders supported on concrete or masonry, install as specified above for setting and grouting bearing and leveling plates.

3.5 INSTALLING METAL BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
B. Anchor internal sleeves for removable bollards in concrete by inserting into pipe sleeves preset into concrete. Fill annular space around internal sleeves solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward internal sleeve.

C. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner will furnish padlocks.

D. Fill bollards solidly with concrete, mounding top surface to shed water.
   1. Do not fill removable bollards with concrete.

3.6 INSTALLATION - SLOTTED CHANNEL FRAMING SYSTEMS:

A. For ceiling channel, rails shall be on centers as required by equipment manufacturer and allow continuous attachment along any point on the rail. System shall be true, plumb, and level to the tolerances specified.

B. Framing shall be adjusted as required in the field to avoid interferences.

C. Hammer drilling times shall be coordinated in existing facilities with the Owner.

D. All bolted connections into cold-formed channel members with channel nuts shall be tightened to a minimum:
   1. 50 ft-lbs for ½” bolts.
   2. 100 ft-lbs for 5/8” bolts.
   3. 125 ft-lbs for ¾” bolts.

E. All bolted connections for structural steel joints shall be per ASIC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

3.7 FIELD QUALITY CONTROL FOR SLOTTED CHANNEL FRAMING SYSTEMS:

A. General: Conventional Testing and Inspection Services specified herein describe those items not specifically required by IBC, but may be considered essential to the proper performance of the slotted channel framing systems.

B. Definitions:
   2. NDE: Non-destructive Evaluation.
   5. Special Inspector -Technical: Shall be employed by a testing agency and shall be supervised by an AWS/CWI with a minimum of 10 years experience or an ASNT Level III with a minimum of 10 years experience.
      a. Technical I: Non-destructive Testing Technician ASNT TC-1A Level I, and/or AWS Certified Associate Weld Inspector (CAWI)
      b. Technical II: Non-destructive Testing Technician ASNT TC-1A Level II, (NDE Technician II), AWS/CAWI, with minimum 3 years experience, or an AWS/CWI.

C. Testing and Inspection Requirements:
   1. Submittals: On a periodic basis, verify mill test reports and other submitted documentation, for compliance with Contract Documents; performed by Technical I.
   2. Materials: On a periodic basis, verify materials delivered to site, comply with Contract Documents and approved Shop Drawings. Materials include slotted channel framing members, clips, accessories, bolts and other fasteners, electrodes, and other structural slotted channel framing support components; performed by Technical I.
3. Detail Compatibility; performed by Technical I:
   a. On a periodic basis:
      1) Review Project documents affecting integrity of structure, including Contract Documents and pertinent submittals (approved Shop Drawings).
      2) Visit site at intervals appropriate to the stage of construction, to perform review of the structure and visually confirm general compliance with the Project documents.
      3) Inspect the following to verify member orientation, configuration, type and size comply with details indicated on the Contract Documents and approved Shop Drawings:
         a) Bracing and stiffening members.
         b) Proper applications of joint details at connections for structural members.
         c) Other work critical to the integrity of the building structure.
   D. Testing agency will report test results promptly and in writing to Contractor and Architect.
   E. Remove and replace Work that does not comply with specified requirements.
   F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.8 TOLERANCES:
   A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
   B. Maximum Offset From True Alignment: 1/4 inch.

3.9 ADJUSTING AND CLEANING:
   A. Immediately following installation, clean field welds, bolted connections, and abraded and rusted areas of shop painted and galvanized finishes and perform required touch-up painting; use appropriate materials to match manufacturer’s shop paint and galvanized finishes.
      1. For shop primed surfaces, apply paint to comply with requirements of SSPC PA 1.
      2. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A780.
   B. Transport debris and excess materials from site and legally dispose of them.

END OF SECTION
SECTION 06410
CUSTOM CASEWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES:
   A. Plastic laminate clad custom casework.
   B. Cabinet hardware.

1.2 RELATED REQUIREMENTS:
   A. Section 09260 - Gypsum Board Systems.
   B. Section 09900 - Painting.

1.3 REFERENCES:
   A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
   F. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
   G. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
   H. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2009 (ANSI/HPVA HP-1).
   I. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
   J. WI (CCP) - Certified Compliance Program (CCP); current edition at www.woodworkinstitute.com/certification.
   K. National Electric Manufacturers Association (NEMA) LD3 - High Pressure Decorative Laminates.
   L. PS 1 - Construction and Industrial Plywood.

1.4 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. **Product Data:**
   1. Provide data for hardware accessories.
   2. Adhesive manufacturer’s product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.

C. Provide UL approved identification on fire retardant treated material.

D. **Shop Drawings:** Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, and schedule of finishes.

E. **Samples:** Submit two (2) samples, illustrating plastic laminate material finish.

1.5 **QUALITY ASSURANCE:**

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum 10 years of documented experience.
   1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Single-Source Responsibility for Fabrication and Installation: Engage qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.

C. Perform all work of this section in accordance with AWI Custom quality standards.

D. **Regulatory Requirements:**
   1. Flame Spread Index: Where fire-retardant treated wood is specified or required by IBC Chapter 8 requirements, provide materials that have been tested in accordance with ASTM E84 by a testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Fire-retardant treated materials shall be identified with appropriate classification markings indicating rating on surfaces that will be concealed from view in the finished work or by separate removable label applied by the treated wood Manufacturer.

1.6 **DELIVERY, STORAGE, AND HANDLING:**

A. Deliver, store and handle products to site under provisions of Section 01600.

B. Protect units from moisture damage.

1.7 **ENVIRONMENTAL REQUIREMENTS:**

A. During and after installation of work of this section, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.

1.8 **FIELD MEASUREMENTS:**

A. Verify that field measurements are as indicated on shop drawings.

1.9 **COORDINATION:**

A. Coordinate the work with plumbing and electrical rough-in and adjacent finishes.
PART 2 - PRODUCTS

2.1 GENERAL:

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI (AWS) for Premium Grade.

2.2 WOOD MATERIALS:

A. Lumber: PS 20; graded in accordance with established Grading rules; maximum moisture content of 4 to 9 percent; of following species and grades:
   1. Structural Light Framing: Select structural; No. 1 grade.
   2. Non-structural Light Framing: Standard grade.

B. Framing Plywood: PS 1; factory grade.

C. Softwood Plywood: Graded in accordance with AWI, Custom Grade.

D. Wood Particleboard: AWI standard, composed of wood chips, medium density of grade to suit application; sanded faces.

E. Masonite: ANSI A135.4, pressed wood fiber with resin binder, tempered grade, smooth both sides. Provide in thicknesses shown on drawings.

2.3 WOOD TREATMENT PROCESS:

A. Fire-Retardant Treatment:
   1. All architectural woodwork used in the interior of the building shall be fire retardant treated, except where allowed otherwise by Code.
   2. Fire Retardant: Chemically treated and pressure impregnated; capable of providing flame spread/smoke developed ratings as follows and in accordance with ASTM E84 and as defined by IBC Chapter 8 requirements.
      a. Interior Wall and Ceiling Finishes:
         1) Vertical Exits, Exit Access Corridors, Exit Passageways and Other Exit ways: Class "B" (26-75) flame spread index, 0-450 smoke developed.
         2) Rooms and Enclosed Spaces: Class "C" (76-200) flame spread index, 0-450 smoke developed.
      b. Trim (moldings, chair rails, baseboards, handrails, wood door and window frames, and similar decorative items):
         1) All Areas: Class "C" 76-200 flame spread, 0-450 smoke developed.
   3. Where wood is indicated to be clear finished or stained, do not use fire-retardant treatment with colorants, that would bleed through the finish, or that would otherwise adversely affect finish.

2.4 PLASTIC LAMINATE MATERIALS:

A. Manufacturers:
   2. Nevamar: www.nevamar.com

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as scheduled.
   1. Finishes, colors, patterns and textures as indicated on the Drawings or selected by the Architect.
2. **Laminate Backer:** BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

D. **Plastic Laminate:** NEMA Standards, high pressure plastic laminate, 0.050 inch at horizontal surfaces, 0.030 inch at vertical surfaces, General Purpose quality, color and finish as shown on drawings.

E. **Laminate Backing Sheet:** 0.020 inch Backing Sheet grade, undecorated plastic laminate.

2.5 **HARDWARE:**

A. **Hardware:** BHMA A156.9, types as indicated for quality grade specified.

B. **Shelf Standards:** Knape & Vogt, 255 NP series steel, recessed pilaster standards with 1/2” adjustments.

C. **Adjustable Shelf Supports:** Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.

D. **Cabinet Locks:**
   1. Keyed cylinder, two keys per lock, steel with chrome finish.
   2. Best 5L Series Dead Bolt, Rim Mounted Cabinet Locks, individual keyed per room and master keyed.

E. **Catches:** Magnetic catch at each door, heavy duty with 100 lb. pull.

F. **Drawer Slides:**
   1. Type: Extension types as required.
   2. Conforming to ANSI/BIFMA X5.6, UL 1678 and UL 1286.
      a. Light and medium duty drawers - 24 inch wide or less: Accuride 7432 ball bearing, rail mount, full extension slides with 100 lb. /pr. load rating. Provide Accuride 7434 overtravel slides where drawers require full access.
      b. Heavy duty drawers - 42 in wide or less: Accuride 3640A ball bearing, rail mount, full extension slides plus 1 inch (25mm) overtravel with 200 lb. /pr. load rating.
      c. Finish: Clear zinc.
   3. Static Load Capacity: Commercial grade.
   5. Stops: Integral type.
   7. Products:

G. **Hinges:** Blum sprung 125 deg. clip type or approved equal.

H. **Door and Drawer Pulls:** Clear anodized aluminum wire pulls, Euroconcepts "300A Series".

I. **Grommets:** Minimum of six (6) 3 inch diameter plastic or vinyl cable grommets with covers in reception counter. Locations to be determined by Owner.
2.6 ACCESSORIES:

A. Edge Trim for Wood Veneer Faced Casework: Matching solid hardwood edge of same species as face veneer. Thickness and profile as indicated on Drawings or as selected, 1/8 inch minimum.

B. Adhesive: Type recommended by AWI or laminate manufacturer to suit application.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application.

E. Concealed Joint Fasteners: Threaded steel.

F. Sealant: As specified in Section 07900 - Joint Sealants.

2.7 FABRICATION:

A. All work shown to be plastic laminate clad shall be in accordance with the tolerances and requirements of AWI, Section 400B, Laminate Clad Cabinets; Custom Grade.

B. Fabricate to design and details as shown on the drawings.

C. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.

D. Cap exposed plastic laminate finish edges with material of same finish and pattern.

E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.

G. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.

H. Mechanically fasten back splash to countertops with steel brackets.

I. Provide cutouts for plumbing fixtures, inserts, outlet boxes fixtures and fittings and control boxes. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges. Provide vinyl grommets, sized for opening, at all exposed cutouts.

J. Sand hardwood trim and ease exposed edges. Finish with transparent stain, selected by Architect, and as specified in Section 09900 – Painting and Coatings.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION:

A. Set and secure casework in place; rigid, plumb, and level.
B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining casework units and counter tops.

D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

E. Secure casework and counter bases to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

G. Coordinate with Division 16 for lighting fixtures, conduit, boxes and controls.

3.3 ADJUSTING:

A. Adjust moving or operating parts to function smoothly and correctly.

B. Adjust all drawers and doors for even clearances and horizontal alignment.

3.4 CLEANING:

A. Clean casework, counters, shelves, hardware, fittings and fixtures.

END OF SECTION
SECTION 06640
FIBER REINFORCED PLASTIC (FRP) PANELING

PART 1 - GENERAL

1.1 SUMMARY:
A. Section Includes: Fiberglass reinforced plastic (FRP) paneling for wall and ceiling surfaces, including trim accessories.

1.2 RELATED SECTIONS:
A. Section 06100 - Rough Carpentry.
B. Section 09111 - Non-Structural Metal Framing.
C. Section 09260 - Gypsum Board Assemblies.

1.3 REFERENCES:
A. General: Standards listed by reference form a part of this specification section. Standards listed are identified by issuing authority, abbreviation, designation number, title or other designation. Standards subsequently referenced in this Section are referred to by issuing authority abbreviation and standard designation.

1.4 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Technical Data: For each type of product required.
C. Shop Drawings: Showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.
D. Samples: Selection and verification samples for finishes, colors and textures. Submit 4 samples of each type of panel, trim and fastener.
E. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.
F. Test and Evaluation Reports: Showing compliance with specified performance characteristics and physical properties.

G. Manufacturer’s Instructions: Manufacturer’s Installation Guide for FRP.

H. Qualifications Statements: For manufacturer and installer.

I. Closeout Submittals:
   1. Refer to Section 01782 - Operation and Maintenance Data.
   2. Operation and Maintenance Data: For installed products including maintenance methods and precautions against cleaning materials and methods detrimental to finishes and performance.
   3. Warranty: Warranty documents required in this section.

1.5 MAINTENANCE MATERIAL:

A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Section 01770 - Closeout Procedures and Submittals.
   1. Quantity: Furnish quantity of units equal to 10% percent of amount installed.
   2. Delivery, Storage and Protection: Comply with Owner’s requirements for delivery, storage and protection of extra materials.

1.6 QUALITY ASSURANCE:

A. Manufacturer Qualifications:
   1. At least ten (10) years experience in the manufacturing of fiberglass reinforced plastic panels.
   2. Provider of advanced installer training.

B. Installer Qualifications:
   1. At least five (5) years experience in the installation of fiberglass reinforced plastic panels.
   2. Experience on at least five projects of similar size, type and complexity as this Project.
   3. Employer of workers for this Project who are competent in techniques required by manufacturer for installation indicated.

C. Surface-Burning Characteristics: Determined by testing identical products according to ASTM E84 by a testing agency acceptable to authorities having jurisdiction.
   1. Flame-Spread Index: 25 (Class A) or less.
   2. Smoke-Developed Index: 450 or less.

D. Meets USDA/FSIS requirements.

1.7 DELIVERY, STORAGE AND HANDLING:

A. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.

B. Storage and Handling: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels in a dry indoor location at Project site. Remove any foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.
1.8 PROJECT CONDITIONS:

A. Ambient Conditions:
   1. Do not begin installation until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.
   2. During installation, and within 48 hours prior to installation, maintain ambient temperature and relative humidity within limits required by type of panel adhesive used and recommendation of panel adhesive manufacturer.

1.9 WARRANTY:

A. Refer to Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace FRP panels that fail within specified warranty period.
   1. Failures shall include, but not be limited to substantial defects in material and workmanship, rotting, rusting, corrosion, development of structural surface cracks, or requiring painting or refinishing.
   2. Warranty Period: Ten years from date of Substantial Completion.

C. Special Warranty: Installer's standard form in which installer agrees to repair or replace FRP panels that fail due to poor workmanship or faulty installation within the specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design Product: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
   1. Subject to compliance with requirements provide Crane Composites, Inc.; Glasbord Fiberglass Reinforced Plastic (FRP) Panels,

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed. Submit as substitution according to Conditions of the Contract and Division 1 Sections.
   1. Marlite; 202 Harger Street, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.

C. Substitutions: See Section 01630 – Product Substitutions for substitution procedures.

2.2 FIBERGLASS REINFORCED PLASTIC (FRP) PANELS:

A. General: Fiberglass reinforced plastic panels complying with ASTM D5319.

B. Product Options:
   1. Color: White
   3. Nominal Thickness: 0.09 inch.(2.3 mm)
4. Wall Panel Size: As indicated on drawings.
5. Surface Protection: Manufacturer’s proprietary molecularly-bonded surface protection film for fiberglass reinforced plastic (FRP) panels.

C. Performance Criteria (Class A - Panels):
1. Flexural Strength: 13.6 x 10^3 psi (94 Mpa), ASTM D790.
2. Tensile Strength: 7.1 x 10^3 psi (49 MPa), ASTM D638.
4. Abrasion Resistance: Taber Abrasion Test using CS-17 abrasive wheels with 1000 g weight. Panels shall exhibit weight loss after 25 cycles of no more than 0.038 percent.
5. Impact Strength ASTM D3029, 45 in-lb. (5.1 J) showing no visible damage on finish side.
6. Water Absorption: 0.16 percent in 24 hours at 77 deg F (25 deg C), ASTM D570.

2.3 ACCESSORIES:

A. Moldings: PVC Pattern-matched to panel.
   1. Color: Match Panels

B. Panel Adhesive: As recommended by panel manufacturer for the required substrates.
   1. Adhesive shall have a VOC content of 50 g/L or less.

C. Panel Sealant: Single-component, mildew-resistant silicone.
   1. Sealant shall have a VOC content of 250 g/L or less.

2.4 SOURCE QUALITY CONTROL:

A. Obtain fiberglass reinforced panels, moldings and other accessories from a single manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. General: Comply with manufacturer’s product data, including product technical bulletins, and installation instructions in product catalogs and product packaging.

B. Verify that substrates previously installed under other sections are acceptable for product installation in accordance with FRP manufacturer’s instructions.
   1. Examine substrate surfaces to determine that corners are plumb and straight, that surfaces are smooth, sound and uniform, that nails or screw fasteners are countersunk, and that joints and cracks are filled flush and smooth with adjoining surfaces.
   2. Do not begin panel installation until substrate surfaces are in satisfactory condition.

3.2 PREPARATION:

A. Clean substrates to remove substances that could impair bond of adhesive, including oil, grease, dirt, dust or other contamination.

B. Condition panels by unpacking and placing in installation space no less than 24 hours before installation.

C. Lay out paneling before beginning installation. Locate panel joints to provide equal panel widths at ends of walls and so that trimmed panels at corners are not less than 12 inches (300 mm) wide.
3.3 INSTALLATION:

A. General: Comply with panel manufacturer’s Installation Guide.

B. Cut and drill panels, finished face down, with carbide tipped saw blades or drill bits, or cut with snips.

C. Install panels with manufacturer’s recommended gap for panel field and corner joints.
   1. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener.
   2. Install panels in a full spread of adhesive. For trowel type and application of adhesive, follow adhesive manufacturer’s recommendations.

D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

E. Sealant:
   1. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
   2. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths.

F. Tolerances:
   1. Width: ±1/8” (±3.2 mm)
   2. Length: ±1/8” (±3.2 mm) up to 12’ (3.7 m)
   3. Squareness: ±1/8” (3.2 mm) in 48” (1.2 m) of width

3.4 FIELD QUALITY CONTROL:

A. Manufacturer’s Field Services: If requested by Owner, provide manufacturer’s field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer’s instructions.

3.5 CLEANING:

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace any installed products that have been damaged.

C. Clean installed panels in accordance with manufacturer’s instructions prior to Owner’s acceptance.

D. Remove and lawfully dispose of construction debris from project site.

3.6 PROTECTION:

A. Protect installed product and finish surfaces from damage during construction.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Board insulation as indicated on the drawings.

B. Batt insulation and vapor retarder in exterior wall and ceiling construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

D. Acoustic insulation.

1.2 RELATED REQUIREMENTS:

A. Section 05 40 00 - Cold-Formed Metal Framing:

B. Section 07 54 00 – PVC Thermoplastic Membrane Roofing: Installation requirements for board insulation over low slope roof deck specified in this section.

C. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

D. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.3 REFERENCE STANDARDS:


1.4 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
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.
D. Manufacturer’s Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
E. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE:
A. Comply with regulatory agency requirements for fire resistance ratings and surface burning characteristics.
B. Provide certification that product conforms to the required fire resistive requirements.

1.6 DELIVERY AND STORAGE:
A. Deliver materials to the project in Manufacturer's original packaging and labels. Protect against damage to the product.

1.7 FIELD CONDITIONS:
A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.

C. Substitutions: See Section 01630 - Product Substitutions.
2.2 APPLICATIONS:

A. Insulation over Metal Stud Framed Walls, Continuous: Extruded polystyrene board.
B. Insulation in Metal Framed Walls: Unfaced Batt insulation.
C. Insulation Above Lay-In Acoustical Ceilings: Unfaced Batt insulation.
D. Insulation Over Roof Deck: Polyisocyanurate board.

2.3 FOAM BOARD INSULATION MATERIALS:

A. Expanded Polystyrene (EPS) Board Insulation: ASTM C578, Type XI; with the following characteristics:
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   4. Board Size: 48 x 96 inches.
   5. Board Thickness: 1-1/2 inches.
   7. Water Absorption: 4 percent by volume, maximum.
   8. Board Density: 0.7 lb./cu ft.
   10. Thermal Resistance: R-value of 3.1 per 1 inch at 75 degrees F mean temperature.
   11. Thermal Conductivity (k factor) at 25 degrees F: 0.28.

B. Extruded Polystyrene (XPS) Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
   4. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
   6. Water Absorption, Maximum: 0.3 percent, by volume.

C. Manufacturers:
   1. Basis of Design:
   2. Acceptable:

2.4 BATT INSULATION MATERIALS:

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   5. Thermal Resistance:
      a. Roofs and Soffits: R-30 min.
      b. Walls: R-19 min.
c. Thickness: R5.7 per inch = one layer at 3” and one layer at 2.5” which will equate to an R31.35 roof rigid insulation value.


7. Manufacturers:
   a. Basis of Design:
   b. Acceptable Manufacturers:
      2) Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com.

B. Sound Attenuation Batts:
   1. Type: Unfaced glass fiber acoustical insulation complying with ASTM C 665, Type I.
   2. Size:
      a. Thickness: 3½” (89mm), Width: 16” (406mm) or 24” (609mm), Length: 96” (2438mm).
   3. Surface Burning Characteristics:
      a. Maximum flame spread: 10
      b. Maximum smoke developed: 10
      c. When tested in accordance with ASTM E 84.
   4. Combustion Characteristics:
   5. Fire Resistance Ratings:
      a. Passes ASTM E 119 as part of a complete fire tested wall assembly.
   7. Dimensional Stability:
      a. Linear Shrinkage less than 0.1%
   8. Manufacturers:
      a. Basis of Design:
      b. Acceptable Manufacturers:

2.5 ACCESSORIES:

A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

B. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

D. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.

E. Wire Mesh: Galvanized steel, hexagonal wire mesh.

F. Adhesive: Type recommended by insulation manufacturer for application.
PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT CAVITY WALLS:

A. Adhere a 6 inch wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints between sheets.
   2. Extend sheet full height of joint.

B. Install boards to fit snugly between wall ties.
   1. Place membrane surface against adhesive.
   2. Place membrane surface facing out, and tape seal board joints.

C. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.
   4. Place impale fastener locking discs.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

E. Place 6 inch wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.

3.3 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK:

A. Installation of board insulation over low slope roof deck is specified in Section 07540.

B. Board Installation Over Roof Deck, General:
   1. See applicable roofing specification section for specific board installation requirements.
   2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
   3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
   4. Do not apply more insulation than can be covered with roofing in same day.

3.4 BATT INSTALLATION:

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall, roof, and ceiling 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.
E. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.

F. Tape insulation batts in place.

G. Retain insulation batts in place with string wire of other method approved by the Architect.

H. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

I. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.

J. Tape seal tears or cuts in vapor retarder.

K. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.5 ACOUSTIC INSTALLATION:

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Comply with manufacturer’s instructions for particular conditions of installation in each case.

C. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

D. Batts may be friction fit in place until the interior finish is applied. Install batts to fill entire Stud cavity. If stud cavity is less than 96” in height, cut lengths to friction fit against floor and ceiling tracks, walls with penetrations require that insulation be carefully cut to fit around outlets, junction boxes and other irregularities.

E. Where walls are not finished on both sides and insulation does not fill the cavity depth, supplementary support must be provided to hold product in place.

F. Where insulation must extend higher than 8 feet, temporary support can be provided to hold product in place until the finish material is applied.

G. Acoustic Sealant: Refer to Section 07900 - Joint Sealants.

3.6 PROTECTION:

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION
SECTION 07540
PVC THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Roofing System: This specifies the following mechanically-attached roofing system:
   1. Seam-attached single-weld system.
   2. Polyisocyanurate Roof Insulation.
   3. Fiberglass-faced roof board, attached with mechanical fasteners.
   4. Prefabricated flashings, corners, parapets, stacks, vents, and related details.
   5. Fasteners, adhesives, and other accessories required for a complete roofing installation.
   6. Membrane and/or Clad Metal Flashing.
   7. Roofing Accessories.
   8. Traffic Protection

B. State of Nevada Roofing Warranty Agreement (included in Contract Forms).


1.2 RELATED SECTIONS:

A. Section 07213 - Building Insulation.

B. Section 07620 - Sheet Metal Flashing and Trim.

C. Section 07710 - Roof Accessories.

D. Section 07723 - Roof Hatches.

1.3 REFERENCES:


C. Factory Mutual (FM) Engineering Corporation - Roof Assembly Classifications.


E. NRCA - The NRCA Roofing and Waterproofing Manual.

F. Underwriters Laboratories (UL) - Fire Hazard Classifications.

1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data:
   1. Copies of current relevant information pertaining to the primary components to be used in the roof system including but not limited to:
      a. Specifications
b. Roofing’s Warranty  
c. Applicator’s Warranty  
d. Product Data Sheets  
e. Material Safety Data Sheets  
f. FM/UL listings/approvals  
g. UL Environment validation of recycling claims  

C. Shop drawings: Include plans, elevations, sections, details, and attachments to other work, including:
   1. Base flashings and membrane terminations.  
   2. Tapered insulation, including slopes.  
   3. Roof plan showing orientation of roof deck, orientation of roofing membrane, pattern for insulation attachment, and membrane fastening spacing.  
   4. Fastening patterns for corner, perimeter, and field-of-roof locations  

D. Submit a letter from the primary roofing materials manufacturer stating that the Roofing Contractor is a certified applicator of the roofing material submitted.  

E. Submit manufacturer’s product specifications, installation instructions and general recommendations for each principal roofing system product required.  

F. Submit material manufacturer product data and MSDS sheets for each product to be used.  

G. Submit 12 inch x 12 inch samples of roofing membrane, insulation and walkpad materials, as well as samples of membrane and insulation fasteners, bagged and labeled.  

H. Submit State data confirming Contractor has been licensed under same company name for no less than 10 years.  

I. Submit Upon Completion:  
   1. Contractor Guarantee  
   2. Manufacturer Guarantee  
   3. Contractor shall furnish to the Owner the manufacturer’s printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration additional policies, temporary repairs and leak call procedures.  

1.5 QUALITY ASSURANCE:  

A. Perform work in accordance with NRCA Roofing and Waterproofing Manual.  

B. Contractor shall have a minimum of five (5) years experience in successfully applying the same or similar materials and shall be approved by the primary materials manufacturer.  

C. Contractor must have a valid Roofing Contractors License under the same company name for a period of no less than 10 years.  

D. The Contractor shall notify the Owner and Architect in a timely manner of the proposed start date of the roof application.  

E. Upon commencement of the roofing work, the Contractor shall diligently and continuously pursue the project until completion.  

F. The Contractor shall employ sufficient installers and have proper equipment and materials on site so as to complete the work in a timely manner.  

G. All roll goods must be manufactured by the primary roofing manufacturer. No private labeled products will be allowed.
H. Whenever specification items found herein are less stringent than Manufacturers’ requirements, Manufacturers’ requirements shall be followed.

1.6 REGULATORY REQUIREMENTS:

A. Conform to applicable code for roof assembly wind uplift and fire hazard requirements.

B. Fire Exposure: Provide membrane roofing materials with the following fire-test-response characteristics. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
   1. Exterior Fire-Test Exposure:
      a. Class A; ASTM E108, for application and roof slopes indicated.
   2. Fire-Resistance Ratings: Comply with ASTM E119 for fire-resistance-rated roof assemblies of which roofing system is a part.
   3. Conform to applicable code for roof assembly fire hazard requirements.

C. Underwriters Laboratories, Inc.: Class A Assembly

D. Factory Mutual Research Corporation (FM): Class 1-75

E. System shall meet minimum wind design requirements of the most recent version of ASCE 7.

1.7 DELIVERY, STORAGE AND HANDLING:

A. All materials shall be new.

B. Deliver materials to jobsite in original, unopened packaging with legible labels. Package labels shall indicate product name, production date, product code and testing agency.

C. Protection:
   1. Materials shall be properly stored off of the ground on pallets, minimum 4 inches high and off the roof.
   2. Completely cover all materials with breathable watertight covering.
   3. Visqueen or other non-breathable plastic coverings shall not be used.
   4. Unprotected, moist or damaged materials shall be conspicuously marked and permanently removed from the job site.

D. Contractor shall only place enough roofing materials on the roof structure for that day’s work.

E. At no time shall Contractor load or permit any part of the structure to be loaded with a weight that will endanger the safety of the structure.

F. Select and handle material handling equipment to avoid damage to materials or installed membrane and insulation.

G. Any damaged material shall be conspicuously marked for permanent removal from the jobsite.

H. Adhesive shall be stored at temperatures above 40°F.

I. Any flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined by material manufacturer/supplier.

1.8 PROTECTION:

A. Protect building contents and grounds during the process of the work.
   1. Protect all paving, walls of building and building adjacent to hoist prior to starting work.
2. Windows, doorways, docks, walkways, etc., may require special protection measures.

B. Remove all debris daily from the roof and haul off site.

C. Contractor shall be responsible for meeting fire regulations. A certified fire extinguisher of adequate size shall be located on the roof and elsewhere as required.

D. All roofing work shall commence at the furthest point from worker access and progress back towards the access point.

E. Contractor shall be responsible to exercise caution and/or protect finish roofing surfaces during roof-top activities, and to properly repair any damage that may result from such activities.

F. In the event of damage, immediately repair or replace all damaged and/or defective work to the approval of the Architect, and at no additional cost to the District.

G. Contractor must install temporary waterstops at all incomplete roofing locations on a daily basis.

1.9 ENVIRONMENTAL REQUIREMENTS:

A. If inclement weather is anticipated during the work period, Contractor shall take adequate precautions to insure that materials, applied roofing, insulation and building interior are protected from possible moisture damage or contamination.

B. Wind velocity limitation will be based on ability to apply materials safely in specified manner.

C. Special precautions may be necessary when installing the roof system at temperatures below 45°F to insure satisfactory application and performance.

1.10 DELIVERY, HANDLING, AND STORAGE

A. Deliver roofing materials to project site in original containers with seals unbroken and labeled with product manufacturer’s name or product brand name.

B. Comply with most current product data sheet requirements when handling, storing, protecting, or installing roofing materials. Including but not limited to avoiding physical damage, deterioration by sunlight, excessive moisture, or other potentially damaging conditions.

C. Store liquid materials in their original undamaged containers in a clean, dry, protected location; away from direct sunlight; within the temperature range noted on the product data sheet.

D. Handle and store roofing materials and equipment in a manner to avoid permanent deflection of deck.

1.11 PRE-ROOFING COORDINATION CONFERENCE:

A. Prior to installation of the roofing system, the General Contractor shall schedule and attend a roofing coordination meeting.

B. Pre-roofing meeting shall be schedules after submittals and shop drawings have been reviewed and approved, and the deck to receive the roofing can be walked to review the condition of all surfaces to receive roofing.

C. Pre-roofing meeting shall be scheduled at least two (2) weeks prior to the start of any roofing work.
D. Representatives of the following entities shall meet at the project site: Owner, General Contractor, Roofing Contractor, sub-contractors scheduled to perform any work on the roof, roofing manufacturer’s representative, Architect and Owner’s representative.

E. Attendees shall review all pertinent details and specifications, noting any potential problems and making any changes, deletions or additions as deemed necessary. The Conference will include but not be limited to the following:
   1. Guarantee and submittal requirements.
   2. Scheduling and forecast weather conditions.
   3. Regulatory requirements.
   4. Coordination of sub-trades and sub-trade requirements.
   5. Proposed installation procedures.
   6. Roofing details.
   7. Coordination of related work.

1.12 WARRANTY;

A. Refer to Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Contractor shall agree to the provisions of the State of Nevada Roofing Warranty Agreement for a 20 year warranty.

C. Contractor shall submit a fully executed copy of the Roofing Warranty Agreement at the completion of the project.

D. Warranty shall be a full system warranty.

E. Roofing Warranty Agreement is included in the Contract Forms. Owner will provide forms for signature at the completion of the project.

F. In addition to the warranty, the Contractor shall furnish to the Owner the manufacturer’s printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration additional policies, temporary repairs and leak call procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract.
   1. Acceptable Manufacturers:
      a. Flex.
      b. Duro-Last, Inc.

C. Substitutions: See Section 01630 – Product Substitutions for substitution procedures.
2.2 MATERIALS:

A. Roof Membrane:
1. Material: Nominal 60 mil (.060") thick Polyvinyl Chloride (PVC) prefabricated sheet membrane. Prefabricated "half sheets" shall be provided as required for perimeter securement.
2. Manufacturer and Brand: Manufacturer's compliant product.
3. Membrane shall conform to the requirements of the "Energy Star" program as outlined by the Department of Energy (DOE) and the Environmental Protection Agency (EPA).
4. Color: EnergySmart White, initial solar reflectance of 0.83, emittance of 0.90, and solar reflective index (SRI) of 104.
5. Minimum Properties: Refer to Table of Properties chart located below:

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<th>Parameters</th>
<th>ASTM Test Method</th>
<th>Typical Properties</th>
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<td>Elongation min., (% of original)</td>
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B. Flashing Membrane:
1. Material: Nominal 60 mil (.060") thick reinforced PVC as required by manufacturer for intended application.
2. Manufacturer and Brand: Manufacturer's compliant product.
3. Exposed Color: Match membrane color

C. Clad Metal Flashing:
1. A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. 24 gauge, G90 galvanized metal sheet with a 20 mil unsupported roof membrane laminated on one side.

D. Polyisocyanurate Roof Insulation:
1. Material:
a. Closed cell polyisocyanurate foam core shall be reinforced with glass fibers and sandwiched between fiberglass facers integrally laminated to both sides.
b. Foam core shall have rated flame spread of 25 or less according to ASTM E84, and shall have minimum compressive strength of 25 psi (Grade 3).
c. Insulation shall be supplied in 4’x8’ boards.
2. Manufacturer and Brand: Manufactured or approved by Primary Manufacturer.
4. Resistance Value (R): R-30 minimum per LTTR method.
5. Tapered Insulation Slope: 1/2 inch per foot.
6. Configuration as indicated on the Drawings.

E. Membrane and Insulation Fasteners:
   1. Plate: Polymer coated, 3 inch round, 22 gauge corrosion resistant steel plate designed to attach insulation boards to the roof deck and as a substrate for induction welding of the roofing membrane.
   2. Fastener: Manufacturer’s heavy duty corrosion-resistant fastener used to attach to steel decks.
   3. Manufacturer and Brand: Manufactured or Approved by Membrane Manufacturer.
   4. Screw Length: Shortest length as required for 1 inch penetration through top flange of steel deck.

F. Fasteners for Masonry and Sheet Metal:
   1. Masonry nails shall be case hardened.
   2. Fasteners for securement to sheet metal shall be self-tapping sheet metal screws.
   3. One-inch diameter tin caps or integral heads must be used for base flashing securement.
   4. Manufacturer: Submitted and approved products
   5. Size: Sufficient length to penetrate 3/4 inch minimum into masonry, or 1/4 inch minimum penetration through metal.

G. Bonding Adhesive:
   1. Material: Contact adhesive used to secure flashing membranes in place. Do not use on seams.
   2. Manufacturer and Brand: Manufacturer’s standard product.

H. Walkway Protection Pads:
   1. Material: Walkways to be minimum 0.096” (96 mil) thick weldable membrane with non-slip surface embossment, approved by membrane manufacturer and compatible with field membrane.
   2. Manufacturer and Brand: Manufacturer’s standard product.

I. Miscellaneous Accessories:
   1. Lap sealants, caulking compounds, primers, solvents, overnight seal, separator sheets, etc. to be as required, supplied and/or approved by the primary membrane manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contractor shall inspect the deck for acceptability for roofing after all structural and fastening requirements are complete and approved.

B. All curbs shall be of a sufficient height to provide a minimum of 8-inch exposure above the surface of the insulation. The Contractor must not roof in inadequate curbs.

C. Clean all surfaces of debris and of any moisture before proceeding with application of the roofing material.
3.2 GENERAL APPLICATION REQUIREMENTS:

A. Operations shall not be conducted when water in any significant form is present on deck, such as rain, dew, ice, frost, or snow.

B. Precautions shall be taken to keep materials clean, dry and free of damage.

C. Do not start application of more materials each day than can be completed within the same day.

D. At the end of each day, edge-seal the finished portion of the roofing system completed that day according to manufacturer’s recommendations. Remove edge seals prior to the start of the next day’s work.

E. Start roofing work in dry weather only and without threat of immediate inclement weather.

F. Keep the roofed area of the building watertight each day as the work progresses.

G. All membrane seams, roof terminations and openings shall be made waterproof at the end of each day’s work.

H. Use only materials and procedures that are proper and suitable for the slopes and for the underlying materials to which they are attached.

I. Approved and operable fire extinguishers shall be on hand at all times on the roof. All additional requirements of OSHA Safety Regulations will be followed.

3.3 ROOF INSULATION:

A. All roof insulation shall be installed in accordance with the recommendations of both the roof insulation and roof membrane manufacturers.

B. Lay roof insulation in parallel courses with long joints continuous and parallel with the deck flanges.
   1. All long joints must occur over roof deck flanges.
   2. Stagger end joints in adjoining courses by the maximum amount.
   3. Butt each panel tightly to adjoining panels (discard damaged panels).

C. Second layer and any subsequent insulation layers shall be offset from the underlying layer a minimum of 12 inches at the joints.

D. Space roof insulation 1/4” from all vertical flashings. Insulation shall be neatly cut and fit around all through-roof projections.

E. No more insulation shall be laid than can be completely covered in a day’s work. Remove and replace any wet insulation. Roofing shall not be applied over wet insulation.

F. Mechanical Attachment
   1. Boards shall be mechanically fastened to the deck with approved fasteners in a 2 by 2 foot or 2 by 3 foot grid pattern as required by the manufacturer to meet the wind design requirements. Fasteners must be tight enough that the disc does not turn, but not so tight as to deform.

G. Perimeter and Corner Areas
   1. The perimeter and corner area will be determined by the roofing system manufacturer according to ASCE 7 guidelines based on the building height and width and other conditions.
2. Fasteners are to be installed consistently in accordance with fastener manufacturer’s recommendations. Fasteners are to have minimum penetration of 1 inch through the structural deck.
3. Use fastener tools with a depth locator and torque-limiting attachment as recommended or supplied by fastener manufacturer to ensure proper installation.

H. Tapered roof insulation and necessary fill boards forming crickets shall be installed at locations indicated on roof plan(s) and on the high side of roof penetrations and curbs, as well as to provide a smooth transition to roof drains.
1. Install tapered insulation to provide 1/2 inch per foot minimum finished slope.
2. Provide taper edge or other approved method to create a smooth transition at the base of crickets.

3.4 MEMBRANE INSTALLATION:

A. Unroll membrane and position without stretching.
1. Allow the membrane to relax at least 15 minutes when the temperature is above 60°F or 30 minutes when the temperature is below 60°F, prior to installation.
2. Inspect for any damaged membrane.
3. Remove sections of membrane that are creased or damaged.

B. Cut sheets to maximum size possible in order to minimize seams. Membrane shall be installed so that the flow of water is over or parallel to, but never against, the laps.

C. All membrane sheets are to be overlapped as required by manufacturer in order to provide space for fastener and disc placement and for a continuous 2 inch width weld.

D. Each membrane sheet shall be mechanically fastened using appropriate membrane fasteners and disks placed within the membrane overlap.
1. Placement of membrane and spacing of fasteners shall comply with manufacturer’s recommendations and approved shop drawings.
2. Remove and replace any loose or poorly secured fasteners.

E. A minimum of three (3) half-wide sheets of appropriate membrane shall be installed at the perimeter of each roof section/level with full sheets installed over the field of the roof.

F. Perimeter areas shall be determined by the Manufacturers published Standard Fastening Pattern and Guidelines.

G. Induction Welding
1. Activate the weld between membrane and plate using approved portable induction device in accordance with manufacturer’s instructions.
2. The induction coil must be positioned over the center of the plate, +/- 1 inch.
3. Portable induction device must elevate the temperature of the plate from ambient to 400 – 500 degree F.
4. When the induction welding cycle is complete, immediately place a magnetic weight on the welded assembly. This device must be left in place for at least 60 seconds.

H. Quality Control of Induction Welding
1. The Applicator shall check all induction welds each day.
2. Check welds by using an ordinary plunger centered over the welded plate and pull straight up.

I. Welding of Lap Areas:
1. Roofing membrane is to be hot air welded only.
2. All surfaces to be welded shall be clean and dry.
3. Temporary “tack-welding” is not allowed.
4. Provide minimum 3 inch continuous hot air weld at all areas where membrane overlaps.
5. Use a roller to apply pressure to seams in conjunction with welding to insure a positive weld.
6. Check the full length of all seams using a probe with a well-rounded point.
7. Apply appropriate lap sealant at all exposed cut edges.

J. Patching:
1. Any areas where the integrity of the weld is suspect, or where membrane defects occur such as fishmouths, wrinkles, punctures or voids in the seam area, shall be patched using the same membrane material.
2. Using a rounded patch sized to extend at least six inches beyond the defect in all directions, prepare and patch the area in accordance with manufacturer's instructions.
3. Apply lap sealant at all exposed edges of the patch.
4. Patching shall be limited to a maximum of three (3) patches on any 100 square foot area.
5. Excessive patching or damage to the finished roof membrane shall be grounds for requiring replacement of the entire roofing membrane at the Contractor's expense.

3.5 WATERSTOPS:
A. Install temporary cutoffs around incomplete edges of roofing assembly at the end of each day's work and when work must be postponed due to inclement weather.
B. Seal the sheet membrane to the deck or existing membrane.
C. Use a heavy application of roof cement or hot asphalt at least six inches in width overlaid with an embedded reinforcement.
D. Remove the temporary seals completely when work resumes, cutting out the contaminated membrane.
E. Remove all sealant, contaminated membrane, etc. from the work area and properly dispose off-site.

3.6 FLASHING INSTALLATION:
A. Extend horizontal field membrane to the base of vertical surface at walls, curbs, pipes, etc., and cut even.
B. Secure the membrane along the base of walls and around roof penetrations, curbs, etc., using appropriate fasteners placed at 12 inch o. c.
C. At curbs and walls, install flashing sheet extending from at least 4-1/2 inches out over the field membrane, up vertical surfaces
   1. Where possible, extend over the top of curbs or walls and down over the opposite face.
   2. Install reinforcing "boots" at inside and outside corners as required.
D. Clad Metal:
   1. Where clad metal is used, secure flanges to deck using appropriate fasteners placed at 6 inch o. c., staggered, and extend membrane at least three inches over the metal with a minimum 1-1/2 to 2 inch weld.
   2. Extend field membrane onto the entire horizontal portion of the metal, providing a minimum 1-1/2 inch continuous weld.
E. At pipes and similar penetrations, extend appropriate flashing membrane at least five inches onto the field membrane.
1. Create minimum one-inch turn-up of membrane at pipes and overlap with vertical sleeve formed from appropriate flashing membrane.
2. Pre-fab pipe boots may be used only if they meet minimum 8 inch height requirement or are extended as needed.

F. Roof Drains:
1. Internal roof drains require a double layer of flashing membrane welded together, extending from under the drain clamping ring, out onto the roof.
2. This double membrane layer shall be secured with appropriate fasteners placed at 12 inch o. c. around the drain, then overlapped by the field membrane, providing a continuous weld at the overlap.
3. Apply appropriate sealant between the drain rim and the field membrane and between the flashing membrane and clamping ring.
4. Secure clamping ring tightly over both membranes and re-install strainer dome.

G. Provide a continuous weld where the flashing membrane overlaps the field membrane. Where clad metal is used, weld membrane directly to coating on clad metal.

H. Fully adhere membrane to vertical surfaces using appropriate bonding adhesive.
1. Secure top surface of membrane flashing with appropriate fasteners at 12 inch o. c.
2. On high walls, provide additional securement measures if required by manufacturer.

I. Fasten the top edge of membrane flashings at curbs, walls, etc., approximately every 12 inches on center with appropriate fasteners through one-inch diameter metal discs.

J. Clamp the top edge of pipe flashing sleeves over an additional cushion strip and apply appropriate sealant along the top edge.

K. All flashing shall be in accordance with Roof Details and/or manufacturers instructions.
1. Where alternative flashing methods exist, these will be considered upon submission and acceptance of appropriate shop drawings.
2. Where flashing requirements vary from those described herein or on details, submit shop drawings to describe proposed detail modifications prior to job start.

3.7 MISCELLANEOUS WORK ITEMS:

A. Support any pipelines running along the roof surface, as well as duct legs and any non-penetrating supports using approved supports adhered over protection material.
1. The protection material shall extend at least 2" beyond the support on all sides.
2. Secure pipes to supports using galvanized metal clips secured on both sides of pipe.
3. If required, supports shall be stacked and secured together to accommodate elevated pipes.
4. Supports shall be spaced no more than 8 feet apart and installed so as not to impede water flow.

B. Roof Walkways
1. Roof walkways shall be at least 36 inch wide and shall be installed at locations shown on roof plans, including at least two sides of all serviceable mechanical units and at all roof access points, including the base and top of access ladders.
2. Install walkway product in locations indicated, adhere (except edges) to deck sheet, and hot-air weld edges.
3. Roof protection pads shall be spaced as needed to allow for water flow.
4. Secure walk pad by welding to field membrane along all perimeters in accordance with manufacturer's instructions.
3.8 FIELD QUALITY CONTROL:

A. The Contractor shall be responsible for insuring positive drainage around all curbs, roof openings and crickets to roof drains or scuppers.

B. Arrange for roofing system manufacturer's technical personnel to inspect roofing installation upon completion.

C. Repair or remove and replace components of roofing system that do not comply with specified requirements.

D. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

F. Water Test:
   1. A 48-hr. water test of all completed roof systems, including low-slope and metal roofing, as well as adjacent building components, shall be coordinated with the Owner and conducted by the Contractor in the presence of Owner. The water test shall include the following procedures:
      a. At the direction of the Owner, apply simulated rain over all roof areas for at least 15 minutes per area, or as otherwise directed.
      b. In addition to the simulated rain, direct water to all walls, windows, units, penetrations, etc. that occur adjacent to, or within each roof area, using a continuous, unforced hose stream.
      c. Plug all roof drains in each drainage area and allow each to be filled to a depth of 3 to 4 inches measured at the drain areas. Allow to stand for a minimum of 48 hours.
      d. Upon completion of water test, unplug primary drains only and insure that water flows freely without restriction. Verify that no water comes through overflow drain outlets (to insure that pipes are not cross-connected). Then unplug overflow drains and run hose stream directly into overflow drains to insure that water flows freely without restriction through overflow lines.
      e. Perform any necessary corrections to defects noted during or after the water test procedures. Perform additional testing as necessary to further define sources of any noted leakage.
      f. Contractor shall provide and/or arrange for all necessary equipment, supplies, water, etc. as needed to perform these tests. This may include a water truck with fire hose, if necessary.
      g. Water test shall be performed after completion of asphalt paving, and must be completed and verified prior to filing for substantial completion.

G. A final audit punch list shall be made by the Architect upon notice by the General Contractor that roofing is complete. The roofing and related work must be 100% complete or additional inspections will be back charged.

3.9 CLEAN UP:

A. Contractor shall remove any markings resulting from the work, from finished surfaces.

B. He is to keep the roof and premises clean and free from accumulations of waste materials and rubbish at all times.

C. He shall remove all debris, scrap, and rubbish from the work area daily.
D. Surplus materials and all equipment shall be promptly removed from the site upon completion of the work.

E. Prior to final acceptance, the Contractor shall restore all areas affected by his work to their original state of cleanliness and repair all damage done to the premises, by his workmen and equipment.

3.10 PROTECTION:

A. General Contractor and Roofing subcontractor shall protect the finished roofing membrane at all times during and after roof installation.

B. No work, including staging or access to other portions of the work, shall be permitted on the finished membrane unless approved by the Owner.

C. All roofing work shall commence at the furthest point from worker access and progress back towards the access point.

D. If staging, access, or work is required on the finished membrane, the Contractor shall provide protection along the access path and under the work extending 48 inches beyond the required work area.

E. Protection shall consist of 3/4 inch plywood over a heavy canvas tarp with sand bag ballasts as required to prevent the plywood from becoming airborne during strong winds.

END OF SECTION
SECTION 07620
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Counterflashing and reglets.
B. Flashing and counterflashing at equipment bases and roof hatches.
C. Pre-manufactured metal cap flashing.
D. Reglets and accessories.

1.2 RELATED SECTIONS:

A. Section 04200 - Unit Masonry.
B. Section 07540 - PVC Thermoplastic Membrane Roofing.
C. Section 07710 - Roof Accessories.
D. Section 07723 - Roof Hatches.

1.3 REFERENCES:

A. ASTM A525 - Steel Sheet, Zinc Coated by the Hot-Dip Process.
B. ASTM A792 - Steel Sheet, 55 Percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
C. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors’ National Association; 2012.

1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data: Manufacturer's literature on factory fabricated items.
C. Shop Drawings:
   1. Indicate material profile, jointing pattern sizes, thicknesses and types of materials, finishes, fabrication details, anchors, connections, expansion joints and relation to adjacent work.
   2. Drawings shall be drawn to 1” = 1’ - 0” or larger scale.
D. Samples:
   1. Submit five (5), 12” square samples of the specified painted metal to be exposed as flashing or trim.
   2. Samples shall be reviewed by the Owner for color and texture only.

1.5 QUALITY ASSURANCE:

A. Standards:
   1. Perform work in accordance with SMACNA 1793 and CDA A4050 requirements and
standard details, except as otherwise indicated.


B. Performance Requirements: Designed and installed to withstand project specific wind uplift pressures in compliance, at a minimum, with FMG Loss Prevention Data Sheet 149 and per IBC 2012 Chapter 15 and 16.

C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five (5) years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS:

A. Sheet metal: ASTM A525, minimum 24 gauge G90 hot-dipped galvanized steel smooth commercial grade.

B. Fasteners:
   1. Fasteners shall be of same material or compatible with sheet metal being fastened.
   2. Galvanized steel, with soft neoprene washers.
   3. Rivets, screws and bolts shall be hard copper, brass or bronze except screws for aluminum shall be aluminum or stainless steel with exposed heads anodized to match sheets.

C. Sheet Waterproofing: 60 mil thick, cured, non-reinforced EPDM membrane flashing where not in contact with PVC Thermoplastic Membrane Roofing specified in Section 0754.

D. Clad Metal Flashing:
   1. A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. 24 gauge, G90 galvanized metal sheet with a 20 mil unsupported roof membrane laminated on one side.

2.2 FABRICATION:

A. Fabrication Standard: Fabricate work as shown and to comply with SMACNA "Architectural Sheet Metal Manual".

B. Units shall be of profile and dimensions shown on drawings complete with formed joint covers and flashing assembly and with prefabricated (mitered and solder) corner units.

C. Form sections true to shape, accurate in size, square, and free from distortion or defects.

D. Fabricate cleats of same material as sheet, minimum 6 inches wide, interlocking with sheet.

E. Form pieces in longest possible lengths.

F. Hem exposed edges on underside 1/2 inch; miter and seam corners.

G. Form material with flat lock seams, except where otherwise indicated. At moving joints, use
sealed lapped, bayonet-type or interlocking hooked seams.

H. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

I. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

J. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.3 REGLETS:

A. Where indicated on drawings all reglets installed shall be as manufactured by
   1. Fry Reglet Corporation (Basis of Design).
   3. Approved Equal.

B. Surface Mounted Reglet: Type SM Springlok Flashing System.

C. Concrete Reglet: Type CO Springlok Flashing System.

D. All reglets shall be 24 gauge galvanized steel with standard zinc finish with 2” factory formed end lap at reglet and 3” lap at flashing.

E. Sealant to be concealed in Completed Work: Non-curing butyl sealant.

F. Sealant to be exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

C. Obtain field measurements prior to fabrication and installation.

D. Beginning of installation means acceptance of existing conditions.

E. Install starter and edge strips, and cleats before starting installation.

F. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

G. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

H. Coordination: Coordinate with other Work which affects, connects with, or will be concealed by this Work.

3.2 INSTALLATION:

A. Shop fabricate all items requiring soldering or welding, unless noted otherwise.
B. Sheet metal work shall be of material and gauge specified, and shaped to install in strict conformance with details on drawings or on approved shop drawings.

C. Form sheet metal work lines, arises, and angles sharp and true.
   1. Reinforce all metal flashing corners.
   2. Plane surfaces shall be free from waves or buckles.

D. Mechanically fasten and solder all lap joints, splices, transitions, etc., which are not designed for expansion, contraction and watertightness.

E. Fasten metal for strength by solid riveting, welding or forming double lock seams.

F. All exposed metal edges are to be turned back into hemmed edge.

G. Use elastomeric sealant where necessary to make a watertight installation, including foam backer rod where necessary to make a good sealant joint.

H. Screw fasteners are to be turned into place rather than driven.

I. Form all corner, transition and termination pieces as a single unit, and do not extend less than 4 inches nor more than 12 inches in any direction.

J. All metal tie-in flanges for pipe flashings, etc. shall be at least 4 inches wide.

K. Vertical counterflashing flanges shall be at least 3 inches wide unless otherwise specified.

L. Soldering:
   1. Pre-trim edges of sheet metals before soldering is begun.
   2. Apply flux and begin soldering immediately.
   3. Soldering shall be done slowly with well heated soldering irons until the seams are thoroughly heated and the solder has been completely sweated through the full width of the seams.
   4. After soldering, all acid flux residue shall be removed with a solution of washing soda in water.

M. Install pre-manufactured coping system in accordance with manufacturer's instructions and in configuration shown on drawings.

3.3 FIELD QUALITY CONTROL:

A. See Section 01400 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.4 TOUCH-UP AND CLEANING:

A. Touch up field cuts and abraded areas of prepainted sheet metal work after installation.

B. During the course of the Work and on completion, remove and dispose of excess materials, equipment and debris away from premises. Leave Work in clean condition.

END OF SECTION
SECTION 07710
ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Manufactured curbs, equipment rails, and pedestals.

1.2 RELATED REQUIREMENTS:

A. Section 05310 - Steel Decking
B. Section 05500 – Metal Fabrications: For slotted channel framing system.
C. Section 07540 - PVC Thermoplastic Membrane Roofing.
D. Section 07620 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.
E. Section 15140 - Pipe Supports and Anchors.

1.3 REFERENCE STANDARDS:


1.4 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittal requirements.
B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.
C. Shop Drawings: Submit detailed layout developed for this project. Show dimensioned location and number for each type of roof accessory.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.
PART 2 - PRODUCTS

2.1 MANUFACTURED CURBS:

A. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:

B. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:
   Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
   1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
   2. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing insulation; 1:1 slope; minimum cant height 4 inches.
   3. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
   4. Provide the layouts and configurations shown on the drawings.

C. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
   1. Provide preservative treated wood nailers along top of curb.
   2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
   3. Height Above Finished Roof Surface: 6 inches, minimum.
   4. Height Above Roof Deck: 14 inches, minimum.

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. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION:

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.

3.4 CLEANING:

A. Clean installed work to like-new condition.

3.5 PROTECTION:
A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 07723
ROOF HATCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Prefabricated roof hatches with integral support curbs, operable hardware, and counterflashings.

1.2 RELATED REQUIREMENTS:

A. Section 05310 - Steel Decking:
B. Section 05500 - Metal Fabrications: for metal vertical ladders for access to roof hatches.
C. Section 07540 - PVC Thermoplastic Membrane Roofing:
D. Section 07620 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.3 PERFORMANCE REQUIREMENTS:

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittal requirements.
B. Product Data: Include general construction, configurations, jointing methods, fastening methods and locations when applicable.
C. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
D. Manufacturer’s Installation Instructions: Indicate special installation criteria and interface with adjacent components.
E. Closeout Submittals:
   1. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.5 COORDINATION:

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak-proof, weathertight, secure, and noncorrosive installation.
B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
1.6 QUALITY ASSURANCE:

A. Manufacturer: A minimum of ten (10) years of documented experience manufacturing similar products.

B. Installer: A minimum of five (5) years of documented experience installing similar products.

C. Manufacturer’s Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer’s original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier’s freight bill of lading.

1.8 WARRANTY:

A. Refer to Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Manufacturer’s Warranty: Provide manufacturer’s standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

C. Special Warranty on Painted Finishes: Manufacturer’s standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

1. Approved Manufacturer:

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.

1. Acceptable Manufacturers:
   a. Milcor Inc.
   b. Acudor.
   c. Precision.

C. Substitutions: See Section 01630 – Product Substitutions for substitution procedures.
2.2 ROOF HATCHES:

A. Furnish and install where indicated on plans metal roof hatch Type F, size width: 48" (1219mm) x length: 48" (1219mm). Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.

B. Performance characteristics:
   1. Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m²) with a maximum deflection of 1/150th of the span or 20 psf (97kg/m²) wind uplift.
   2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
   3. Operation of the cover shall not be affected by temperature.
   4. Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

C. Cover: Shall be 11 gauge (2.3mm) aluminum with a 3" (76mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

D. Cover insulation: Shall be fiberglass of 1" (25mm) thickness, fully covered and protected by an 18 gauge (1mm) aluminum liner.

E. Curb:
   1. Shall be 12" (305mm) in height and of
      a. 14 gauge (1.9mm) paint bond G-90 galvanized steel
      b. 11 gauge (2.3mm) aluminum.
   2. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
   3. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.

F. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe:
   1. For aluminum construction: welded to the curb assembly.
   2. For steel construction: through bolted to the curb assembly.

G. Hardware:
   1. Heavy pintle hinges shall be provided.
   2. Cover shall be equipped with a spring latch with interior and exterior turn handles.
   3. Roof hatch shall be equipped with interior and exterior padlock hasps.
   4. The latch strike shall be a stamped component bolted to the curb assembly.
   5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
   6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

H. Finishes: Factory finish shall mill finish aluminum.
2.3 LADDER SAFETY POST

A. Furnish and install where indicated on plans ladder safety post:
   1. Model: LU-1. The ladder safety post shall be pre-assembled from the manufacturer.

B. Performance characteristics:
   1. Tubular post shall lock automatically when fully extended.
   2. Safety post shall have controlled upward and downward movement.
   3. Release lever shall disengage the post to allow it to be returned to its lowered position.
   4. Post shall have adjustable mounting brackets to fit ladder rung spacing up to 14” (356mm) on center and clamp brackets to accommodate ladder rungs up to 1-3/4” (44mm) in diameter.

C. Post: Shall be manufactured of high strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.

D. Material of construction shall be:
   1. Steel.

E. Balancing spring: A stainless steel spring balancing mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post. [For installation in highly corrosive atmospheres, Model LU-3 incorporates a special alloy spring mechanism].

F. Hardware: All mounting hardware shall be Type 316 stainless steel.

G. Finishes: Factory finish shall be:
   1. Yellow powder coat steel (Model LU-1);

2.4 FABRICATION

A. Fabricate free of visual distortions and defects.

B. Weld corners and joints.

C. Provide for removal of condensation.

D. Provide weathertight assembly.

E. Fabricate curbs tapered to maintain hatch top level.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. Coordinate with installation of roofing system specified in Section 07540 and related flashing specified in Section 07620.

B. Apply bituminous paint on metal surfaces of units in contact with cementitious materials and dissimilar metals.

C. Install curb assembly, fastening securely to roof decking. Coordinate with adjacent roofing work for proper flashing.

D. Place roof hatch and secure to curb assembly. Install integral setting sealant and counter-flashing as required by manufacturer.

E. Final installation to be watertight assembly.

F. Adjust all moving parts for smooth operation.

G. Test units for proper function and adjust until proper operation is achieved.

H. Repair finishes damaged during installation.

I. Restore finishes so no evidence remains of corrective work.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09900 – Painting and Coatings.

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 07840
FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Through-penetration firestopping in fire rated wall and floor assemblies.
B. Construction gap and joint firestopping within fire-rated walls and floors.
C. Construction gap and joint firestopping at intersections of the same or different materials in fire-rated construction.
D. Construction gap and joint firestopping at the top of fire-rated walls.
E. Acoustical Fire Rated Outlet Backer Pads.
F. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 RELATED SECTIONS:

A. Section 01453 - Code-Required Special Inspections: Code-required special inspections.

1.3 REFERENCES:

E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014b.
J. FM (Factory Mutual Engineering Corporation) - Fire Hazard Classifications.
   1. Through-Penetration Firstop Device (XHJI)
   2. Fire-Resistive Ratings (BXUV)
3. Through-Penetration Firestop Systems (XHEZ)
4. Fill, Void, or Cavity Material (XHHW)
5. Joint systems (XHBN)

M. WH (Warnock Hersey) - Directory of Listed Products.
N. South Coast Air Quality Management District, Rule #1168.
O. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

1.4 DEFINITIONS:

A. Fire Rated Assembly: Includes all fire rated walls, floors floor/ceiling and roof system assemblies.
B. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.
C. Firestopping: Use of a material or combination of materials to fill or seal openings in fire-rated assembly to restore the integrity of the assembly and prevent the spread of heat, fire gases and smoke.
D. System: Specific products and applications, classified and numbered by Underwriter=s Laboratories, Inc. or other recognized testing laboratory, to seal openings in fire-rated assemblies.
E. Penetration: An opening or object passing through or into a rated wall or floor that breaches the fire-rated assembly or smoke barrier.
F. Construction Gaps: Any gap, joint or opening (static or dynamic) between adjacent sections of walls or floors, at wall topes between top of wall and ceiling, exterior walls and structural floors or roof decks. Where dynamic movement is required the system must comply with UL 2079.

1.5 PERFORMANCE REQUIREMENTS:

A. Penetrations: Provide and install firestopping systems that are produced to resist the spread of fire, and the passage of smoke and other gases according to requirements indicated, including but not limited to the following:
   1. Firestop all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the drawings.
   2. Provide and install complete penetration firestopping systems that have been tested and approved by third party testing agency.
   3. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than one hour or the fire-resistance rating of the construction being penetrated.
   4. T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated.
   5. L - Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, as determined per UL 1479, where indicated.
   6. (Optional) W - Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, as determined per UL 1479, where indicated.
B. Perimeter Fire Containment Systems: Provide interior perimeter joint systems with fire-resistance ratings indicated, as determined per ASTM E2307, but not less than the fire-resistance rating of the floor construction.

C. Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, as determined per UL 2079, but not less than the fire-resistance rating of the construction in which the joint occurs.

D. For firestopping exposed to view, traffic, moisture, and physical damage, provide firestop systems for these conditions that meet conditions expected as communicated through construction documents.

E. Where there is no specific third party tested and listed, classified firestop system available for a particular firestop configuration, the firestopping contractor shall obtain from the firestop manufacturer, an Current Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFERRA) for submittal.

1.7 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: Provide data on material characteristics and performance.

C. Schedule of Firestopping: Provide a list each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
   1. All approved firestopping assemblies including engineering judgments shall be provided and organized by trade.

D. Manufacturer's Systems Manual: Provide current manufacturer's data on all firestopping systems approved by regulatory agencies including materials, barriers, rating limitations and installation instructions of the various products required to comply with established code provisions.

E. General Contractor shall be responsible for assembling of information involving firestopping systems from all trades and making one submittal which shall encompass all firestopping to be used on the Project. Provide full submittal in a tabbed binder with index.

1.8 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with ASTM E814, ASTM E119, ASTM 1479, ASTM E2307, and UL 2079.
   1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icce-es.org will be considered as constituting an acceptable test report.
   3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.

C. Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction condition indicated from a single primary firestop systems manufacturer.
1. Materials of different manufacture than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.

2. Tested and listed, classified firestop systems are to be used. If another manufacturer has a tested and listed system, then that system shall be used prior to an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten (10) years documented experience.

E. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Trained by the direct representative of the manufacturer.
   2. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, Underwriters Laboratories (UL) Approved Contractor, or meeting any two of the following requirements:
      a. With minimum five (5) years documented experience installing work of this type.
      b. Able to show at least (5) satisfactorily completed projects of comparable size and type.
      c. Licensed by authority having jurisdiction.

1.9 FIELD CONDITIONS:

A. Comply with firestopping manufacturer’s recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.
   1. 3M Fire Protection Products: www.3m.com/firestop
   2. Specified Technologies

B. Substitutions: See Section 01630 - Product Substitutions.

2.2 FIRESTOPPING - GENERAL REQUIREMENTS:

A. Firestopping: Any material meeting requirements.

B. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

C. Materials: Use any material meeting requirements.
D. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

E. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

F. Mold Resistance: Provide firestopping materials with mold and mildew resistance rating of 0 as determined by ASTM G21.

G. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

H. Fire Ratings: Refer to Drawings for required systems and ratings.

I. Firestop materials and systems for use in construction gap and joint firestopping of fire-rated construction shall be rated for installation in dynamic (movement) type gap/joint situations in accordance with UL 2079 and IBC.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS:

A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E 2307 to have fire resistance F Rating equal to required fire rating of the floor assembly.
   1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
   2. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
   3. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
   4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

B. Head-of-Wall Firestopping at Joints Between Non-Rated Floor and Fire-Rated Wall: Use any system that has been tested according to ASTM E 2079 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.

C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
   2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
   3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated.
   4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.

D. Through Penetration Firestopping: Use any system that has been tested according to ASTM E 814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
   2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated on drawings.
3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated on drawings.
4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.

2.4 FIRESTOPPING SYSTEMS:

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use any system listed by UL or that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.

2.5 ACOUSTICAL FIRE-RATED PUTTY PADS:

A. Use only backer pads that have been UL 1479 or ASTM E814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, and fire-rating involved for each separate instance.

B. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:

C. Manufacturers:
   2. 3M Fire Barrier Moldable Putty; 3M Fire Protection Products

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify requirements for firestopping for each condition encountered during the course of construction whether shown on drawings or created by the sequence of the Work.

B. Verify that openings are ready to receive the Work of this Section.

C. Provide one copy of approved Manufacture’s Systems Manual on-site at start of construction and ensure manual remains on-site and available to all trades and inspectors during the entire course of the Work.

3.2 PREPARATION:

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may effect bond of firestopping material.

B. Remove incompatible materials which affect bond.

C. Install backing materials to arrest liquid material leakage.

D. Comply with all area and material preparation requirements imposed by the manufacturer and the regulatory agency establishing the designated rating.

E. Sequence work of this section to permit firestopping materials to be installed after adjacent and surrounding work is complete.
F. At horizontal cuts required for pipe penetrations, comply with the following:
   1. Multiple Pipe Penetrations: Horizontal cuts will be backed. This backing will be required to the point that upon pushing the drywall around the pipe penetrations, the drywall is fixed firmly in place.
   2. Moderate contact of all horizontal joints is required.
   3. Less than 2 inch Pipe/Single Penetrations; Additional backing will not be required of the horizontal cut to encircle the pipe. Note that moderate contact of the drywall boards must be maintained to not require additional backing.
   4. Greater than 2 inch Pipe/Single Penetration: Additional backing will be required of the horizontal cut to encircle the pipe.

3.3 APPLICATION:

A. Seal holes: or voids made by penetrating items to requirements of the original fire and smoke rating of the assembly.

B. Seal all intersections and penetrations of floors, ceilings walls and columns. This includes intersection of rated construction with adjacent construction.

C. Seal around all cutouts for electrical, mechanical, plumbing and other work that penetrates fire and/or smoke rated construction assemblies.

D. General: Install firestopping materials to comply with firestopping system manufacturer's written installation instructions and published drawings for products and applications indicated.

E. Apply primer and materials in accordance with manufacturer's instructions.

F. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

G. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping system.

H. Install fill materials for firestopping systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

I. Apply firestopping material in location and sufficient thickness to achieve rating.

J. Install protective material such as sheet metal, gypsum board or other approved materials required to meet the system rating.

K. Tool all sealant type materials concave unless prohibited by rating requirements.

3.4 FIELD QUALITY CONTROL:

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.
C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” and ASTM E2393 - 10a Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers. Inspection agency to examine firestopping and will determine, in general that firestopping has been installed in compliance with requirements of tested and listed firestop systems, and installation process conforms to FM 4911 - Standard for Approval of Firestop Contractors.

1. The Inspector shall advise the Contractor of any deficiencies noted within one (1) working day.
2. Do not proceed to enclose firestopping with other construction until inspection agency has verified that the firestop installation complies with the requirements.
3. Where deficiencies are found, repair or replace the firestopping so that it complies with requirements of tested and listed systems.

D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

E. Manufacturer’s Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.5 IDENTIFICATION & DOCUMENTATION:

A. The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration and joint location on the entire project.

B. The Documentation Form for Through Penetrations is to include:
   1. A Sequential Location Number
   2. The Project Name
   3. Date of Installation
   4. Detailed description of the penetrations location
   5. Tested System or Engineered Judgment Number
   6. Type of assembly penetrated
   7. A detailed description of the size and type of penetrating item
   8. Size of opening
   9. Number of sides of assemblies addressed
   10. Hourly rating to be achieved
   11. Installers Name

C. The Documentation Form for Construction Joints is to include:
   1. A Sequential Location Number
   2. The Project Name
   3. Date of Installation
   4. Detailed description of the Construction Joints location
   5. Tested System or Engineered Judgment Number
   6. Type of Construction Joint
   7. The Width of the Joint
   8. The Lineal Footage of the Joint
   9. Number of sides addressed
   10. Hourly rating to be achieved
   11. Installers Name

D. Copies of these documents are to be provided to the general contractor at the completion of the project.
E. Penetration Identification: Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
   a. Contractor's Name, address, and phone number.
2. Through-Penetration firestop system designation of applicable testing and inspecting agency.
3. Date of Installation.
4. Through-Penetration firestop system manufacturer's name.
5. Installer's Name.

F. Wall Identification: All marking and identification of firewalls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling and shall meet the following requirements:
1. Be in full compliance with Section 703.7 of the International Building Code; 2012.
2. Be located in accessible concealed floor, floor-ceiling or attic spaces.
   a. Height above the ceiling: From 6" to 12".
   b. Both Sides of the wall
3. Be located within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the wall or partition;
4. Include lettering not less than 3 inch (76 mm) in height, with a minimum 3/8 inch (9.5 mm) stroke in a contrasting color incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording indicating type of wall or partition.
   a. Color: bright orange or red.

3.6 CLEANING:
A. Clean adjacent surfaces of firestopping materials.
B. Trim firestopping materials and barrier materials from adjacent surfaces.

3.7 PROTECTION:
A. Protect adjacent surfaces from damage by material and system installation.

END OF SECTION
SECTION 07900
JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES:
A. Joint preparation, priming, backing materials, and weatherseal sealants for exterior and interior wall applications, and accessories indicated, specified, or required to complete application.

1.2 RELATED SECTIONS:
A. Section 07840 – Firestopping: Sealants used in firestopping systems.
B. Section 08800 – Glazing: Sealants used in glazing.
C. Section 09260 - Gypsum Board Systems: Acoustical sealants.

1.3 PERFORMANCE REQUIREMENTS:
A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 REFERENCES:
A. AAMA 800-10 - Voluntary Specifications and Test Methods for Sealants

1.5 SUBMITTALS
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data: For each joint-sealant product indicated; submit:
1. Manufacturer’s technical literature for each product indicated, specified, or required; sealant chemical characteristics, performance criteria, substrate preparation, limitations.
2. Color selection charts. Architect’s acceptance will be for color only.
3. Procedures for priming, backing, installing, tooling, and curing for each type of sealant and each joint condition.
4. Instructions for handling, storage, mixing, and protection of each type of sealant.

C. Shop Drawings: Detailed large-scale drawings in schedule form. Include the following information:
   1. Each type of joint condition and adjacent and adjoining exterior wall materials.
   2. Backings and accessories.
   3. Manufacturers, product name and number, sealant formulation, and sealant color.

D. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE:

A. The Contractor assumes undivided responsibility for the selection, installation and performance of the materials as described above and herein.
   1. Compatibility: Sealants, backings, and accessories shall be compatible with one another, within exterior wall systems and with sealants and materials used by other trades under conditions of service and application.
   2. Joint sealants are required to establish and maintain weather tight continuous seals on a permanent basis, with recognized limitations of wear and aging as indicated for each application.

B. Manufacturer Qualifications: Company with not less than ten (10) years experience in manufacturing products similar to scope of this Project with a record of successful in-service performance.

C. Manufacturers Technical Representative Qualifications: Direct employee of technical services department of manufacturer with minimum of five (5) years experience in providing recommendations, observations, evaluations, and problem diagnostics. Sales representatives are not acceptable.

D. Installer Qualifications:
   1. Experience: Company with not less than ten (10) years experience in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and trained and skilled personnel.
   2. Supervision: Maintain a competent supervisor who is at Project during times specified work is in progress, and, who is experienced in installing work similar in design, products, and extent to scope of this Project.
   3. Manufacturer Training: Installer to be trained in proper application techniques, application sequence and special conditions.

A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.7 PROJECT CONDITIONS:

A. 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.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
1.8 WARRANTY:

A. See Section 01780 - Warranties and Bonds: for additional warranty requirements.

B. Special Warranty
   1. Manufacturers Special Warranty: Furnish full replacement of work warranty for a period of 20 years labor and material, matching that provided by Dow Corning Corporation or GE Silicones, from date of substantial completion due to defects, faulty work and failures, including those that do not comply with specified performance requirements signed by an authorized representative using manufacturer’s standard form.

C. Installers Special Warranty: Furnish full replacement of work warranty for a period of 5 years from date of substantial completion due to defects, faulty work and failures, including those that do not comply with specified performance requirements, signed by an authorized representative using installer’s standard form.

D. Defects, Faulty Work, and Failures: Includes, but not limited to, following:
   1. Adhesive or cohesive failure of sealant.
   2. Abrasion-resistance failure
   3. Lack of resistance to migration.
   4. Staining of substrates from sealant or primers.
   6. Failure to maintain continuous airtight and watertight seal.
   7. Crazing on surface of non-structural sealant.
   8. Non-structural sealant hardening beyond Shore A durometer 50 or softening below 20.

E. Exclusions: Includes, but not limited to, deterioration or failure of sealants from following:
   1. Disintegration of joint substrates from natural causes exceeding design specifications.
   2. Mechanical damage caused by individuals, tools, or other outside agents.
   3. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract:
   1. Dow Corning Corp.
   4. Tremco.
   5. Sika Corp.
   6. Pecora.

B. Substitutions: See Section 01630 - Product Substitutions.

2.2 MATERIALS, GENERAL:

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

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
2. Non-membrane Roof Sealants: 300 g/L.
3. Single-Ply Roof Membrane Sealants: 450 g/L.
4. Sealant Primers for Nonporous Substrates: 250 g/L.
5. Sealant Primers for Porous Substrates: 775 g/L.
6. Modified Bituminous Sealant Primers: 500 g/L.

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

2.3 JOINT SEALERS:

A. Concrete: Horizontal:
1. Two-part Polyurethane, self-leveling.
2. ASTM C920, Type M, Grade P; Class 25, Use T and M.
3. Movement: Plus or minus 25 percent
4. Shore A Hardness: 25
5. Color as selected by Architect from manufacturer’s full line of standard colors. More than one color may be selected.
6. Sonneborn “MasterSeal SL-2”.
7. Tremco “THC-900/THC-901”.
8. Sika “Sikaflex 2C-SL”
9. Pecora “NR-200 Urexpant”

B. Interior:
1. Acrylic latex
2. ASTM C834, Paintable.
3. Color as selected by Architect from manufacturer’s full line of standard colors. More than one color may be selected.
4. Tremco “Tremflex 834”
5. Pecora “AC-20 + Silicone”

C. Restrooms/Counters/Fixtures/Other Wet Locations:
1. Acetoxy Silicone/Silicone
2. ASTM C920, Type S, Grade NS, Class 25, Use NT, G and A.
3. Recommended by manufacturer for use in restrooms and other wet areas, and as not supporting growth of fungus/bacteria.
4. Movement: Plus or minus 25 percent
5. Color as selected by Architect from manufacturer’s full line of standard colors. More than one color may be selected.
6. Pecora “898 Silicone Sanitary Sealant”
7. Dow Corning “Dow 786 Mildew Resistant Silicone Sealant”
8. G.E. “1700 Sanitary Silicone Sealant”

2.4 ACCESSORIES:

A. Primer: Product provided by sealant manufacturer as required by conditions.
1. Non-staining type, recommended by sealant manufacturer to suit application.
2. As recommended by sealant manufacturer in writing, having been tested for staining and durability on samples of actual surfaces to be sealed.
3. Structural silicone in contact with a fluoropolymer painted substrate must be primed with sealant manufacturer’s recommended product and must follow special substrate preparation requirements as described herein.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
C. Cleaners for Non-Porous Surfaces: Chemical cleaners recommended by sealant manufacturer in writing, free of harming residues, non-staining, and formulated to promote optimum adhesion.
   1. MEK, Toluene or Xylene are not acceptable except in cases of extreme cleaning conditions.

D. Foam Backer Rods:
   1. Preformed joint filler, non-staining. Diameter approximately 25 percent larger than joint width, unless otherwise directed by manufacturer.
   2. Bi-cellular Structure with Surface Skin:
      a. Product Quality Standard: ASTM C1330, Type B.
      b. Description: Non-gassing, extruded polyolefin; acceptable to joint sealant manufacturer.
      c. Available Manufacturers and Products:
         1) Nomaco Inc.; SOF-Rod (Dual-Rod) Backer Rod
         2) BASF; Sonneborn, Sonolastic Soft Backer Rod: Degussa
         3) Industrial Thermo Polymers LTD.; Soft-Type Insulating Backer Rod
   3. Closed Cell Structure:
      a. Product Quality Standard: ASTM C 1330, Type C.
      b. Description: Non-gassing, extruded polyethylene; acceptable to joint sealant manufacturer.
      c. Available Manufacturers and Products:
         1) Backer Rod Manufacturing, Inc.; Mile High Foam Backer Rod.
         2) BASF; Sonneborn, Closed-Cell Backer Rod.
         3) Industrial Thermo Polymers LTD.; ITP Std. Insulating Backer Rod.
         4) Nomaco Inc.; Green Rod or HBR Backer Rod.

E. Bond-Breaker Tape:
   1. Description: Teflon or polyethylene tape, self-adhering if necessary, recommended by sealant manufacturer.
   2. Available Manufacturers and Products:
      a. 3M, Industrial Adhesives and Tapes Division; Polyethylene Tape 483.
      b. Norton; TBond II V2200 Foam Spacer, Thermalbond V2100 Foam Spacer.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION:

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer’s written instructions and the following requirements:

B. Joint Cleaning:
   1. Foreign Material: Remove that could interfere with adhesion of sealant, including, but not limited to, dust, loose materials, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Remove protective coatings on metallic surfaces by a solvent that leaves no residue. Use clean white cloths for cleaning with solvent and drying.
   3. Concrete Substrates: Remove laitance and form-release agents.
4. Porous Joint Substrates: Clean by brushing, grinding, mechanical abrading, abrasive blast cleaning, water blast cleaning, or combination of these methods to produce a clean, sound substrate capable of developing optimum bond with sealants. Remove loose particles remaining after cleaning by vacuuming or blowing out joints with oil-free compressed air.

5. Non-Porous Joint Substrates: Clean with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of sealants.

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

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

3.3 INSTALLATION OF JOINT SEALANTS:

A. General: Comply with joint-sealant manufacturer’s written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Sealant Backings: Install to support sealants during application at position required to produce cross-sectional shapes and depth-to-width ratio to allow optimum sealant movement capability.
   1. Foam Backer Rods: Install in joints using tool to control depth; compress rods 25 to 50 percent.
      a. Avoid gaps between ends of rods.
      b. Avoid stretching, twisting, braiding, puncturing, or tearing rods.
      c. Remove absorbent rods that have become wet or damaged before sealant application and replace with dry materials.
      d. Do not apply sealant without back-up materials.
   2. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
   4. Immediately after sealant application and before skinning or curing begins, dry tool sealants to form smooth, uniform beads of slightly concave profile, unless specified otherwise; to eliminate air pockets; and to ensure contact and adhesion of sealant with joint substrates.
a. Remove excess sealant from surfaces adjacent to joints.
b. Do not water wet tool or use tooling agents.

F. Tooling of Nonsag Sealants:
1. 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.
2. Remove excess sealant from surfaces adjacent to joints.
3. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

G. Provide concave joint configuration unless otherwise indicated.
1. Provide flush joint configuration where indicated.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL:

A. Field Inspection:
1. Sealant Manufacturer representative shall inspect first day's work and periodically inspect work to ensure application is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Submit written reports of each visit.
2. State if installation methods complied with the manufacturer's printed instructions and their field representative's verbal instructions and were proper and adequate for the condition of installation and use.

B. Field Adhesion and Cohesion Testing: Sealant manufacturer representative will perform a minimum of 20 field tests to determine if installed work complies with specified requirements. Tests to be witnessed by Owner, Architect. Test sealant after it has fully cured (7-21 days).
1. Destructive Cut and Pull Test.
2. Provide testing as follows to demonstrate curing properties:
   a. Between 24 and 72 hours prior to initial application.
   b. Prior to use of each new shipment of materials.
   c. Not less than twice a month for existing stored materials.

C. Reports: Record test results and prepare reports according to ASTM E575 and ASTM C1521 formats.

D. Re-testing and Re-inspections Due to Failures:
1. Perform further testing to ascertain the extent of the problem. All failed sealants are to be replaced promptly and the resulting weather tightness must be verified.
2. Remove from site marginal or defective material.
3. Contractor responsible for expenses incurred, without additional cost to Owner, due to failure of work to pass testing and inspections.

E. Repairs for Destructive Testing:
1. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints.
2. Ensure original sealant surfaces are clean and new sealant properly contacts original sealant.
3.5 CLEANING:

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

3.6 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.

B. 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 original work.

3.7 POST-OCCUPANCY:

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at the low temperature in the thermal cycle. Report failures immediately and repair.

END OF SECTION
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Non-fire-rated steel doors and frames.
B. Steel frames for wood doors.
C. Thermally insulated steel doors.
D. Sound-rated steel doors and frames.
E. Steel glazing frames.

1.2 RELATED REQUIREMENTS:

A. Section 08710 - Door Hardware.
B. Section 08800 - Glazing: Glass for doors and borrowed lites.
C. Section 09900 – Painting and Coatings: Field painting.

1.3 REFERENCE STANDARDS:

E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
J. ASTM E413 - Classification for Rating Sound Insulation; 2010.
K. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014. (ANSI/BHMA A156.115)


R. SDI 105 - Recommended Erection Instructions for Steel frames.

S. SDI 111 - Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.


V. SDI 124 - Maintenance of Standard Steel Doors and Frames.


1.4 SUBMITTALS:

A. Refer to Section 01330 - Submittal Procedures, for submittal requirements.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

E. Manufacturer’s Certificate: Certification that products meet or exceed specified requirements.

F. Warranty: Executed in Owner's name.
1.5 QUALITY ASSURANCE:

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten (10) years documented experience.

D. Maintain at the project site a copy of all reference standards dealing with installation.

E. Provide a label for each fire rated and sound rated door indicating the testing agencies approval for the required rating. Do not cover or obscure the label in any way.

F. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.

1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM C1363 and meet or exceed the following requirements:
   a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.34, R-Value 2.9, including insulated door, thermal-break frame and threshold.

2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:
   a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Store in accordance with NAAMM HMMA 840.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

1.7 WARRANTY:

A. Refer to Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Special Warranty:
   1. Provide manufacturer's warranty for defects in material and workmanship for the life of the installation.
   2. Include removal of the defective door, hanging, hardware installation, finishing and labeling as required

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

1. Approved Steel Doors and Frames:

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract.

C. Substitutions: See Section 01630 – Product Substitutions for substitution procedures.

2.2 DOORS AND FRAMES:

A. Requirements for All Doors and Frames:
1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Door Top Closures: Flush with top of faces and edges.
3. Door Edge Profile: Bevel edge of lock stile.
5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
7. Galvanizing for Units in Wet Areas: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
8. Finish: Bonderize, apply non lifting, rust inhibitive grey primer compatible with specified finish in Section 09900.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all 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.

2.3 DESIGN CLEARANCES:

A. The clearance between the door and frame head and jambs shall be 1/8" (3.2 mm) in the case of both single swing and pairs of doors.

B. The clearance between the meeting edges of pairs of doors shall be 1/8" (3.2 mm) to 1/4" (6.3 mm), for fire rated doors 1/8" (3.2 mm) ± 1/16" (1.6 mm).

C. The clearance at the bottom shall be 3/8" (9.25 mm) above finish floor, ½" (12.7 mm) at doors with Auto Door Bottom seals.

D. The clearance between the face of the door and door stop shall be 1/16" (1.6 mm) to 1/8" (3.2 mm).

E. All clearances shall be, unless otherwise specified, subject to a tolerance of ± 1/32" (0.8 mm).

2.4 STEEL DOORS:

A. Exterior Doors:
1. Wind resistant building components tested to the following windstorm or severe weather performance standards:
   a. ANSI A250.13
   b. ASTM E330/E1886/E1996
2. Windstorm Certification Label: Each wind-resistant building component shall bear a certification mark of either Underwriters Laboratories Inc. or Intertek Testing Services/Warnock Hersey.
3. Construction: Each wind resistant building component shall be constructed as detailed in the illustrations that follow. Doors over 3'-0" in width that have an exit device must have a horizontal steel stiffener located at centerline of device. When door height is over 7'-0" and design pressure is over 60 PSF and door has mortise lock (single door) or has an ANSI strike with bolts on inactive leaf of pair, vertical lock edge steel stiffeners must be installed.
4. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 2 – Seamless, fully welded.
5. Core: Polyurethane.
8. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
9. Weatherstripping: Separate, see Section 08710.

B. Interior Doors, Non-Fire-Rated:
1. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 2 – Seamless, fully welded.
2. Core: Kraftpaper honeycomb.

C. Interior Doors, Fire-Rated:
1. Grade: ANSI/SDI A250.8 (SDI-100); Level 1 - Standard-Duty, Physical Performance Level C, Model 2 - Seamless.
2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C ("positive pressure").
   a. Rate of Temperature Rise Across Door Thickness: 250 degrees F.
   b. Provide units listed and labeled by UL (Underwriters Laboratories) - UL (BMD).
   c. Attach fire rating label to each fire rated unit.
3. Core: Mineral board.

2.5 STEEL FRAMES:

A. General:
1. Comply with the requirements of grade specified for corresponding door, except:
   a. ANSI/SDI A250.8 (SDI-100), Level 1 Door Frames: 16 gage, 0.053 inch, minimum thickness.
   b. ANSI/SDI A250.8 (SDI-100), Level 2 and 3 Door Frames: 14 gage, 0.067 inch, minimum thickness.
   c. ANSI/SDI A250.8 (SDI-100), Level 4 Door Frames: 12 gage, 0.093 inch, minimum thickness.
   d. Frames for Wood Doors: Comply with frame requirements in accordance with ANSI/SDI A250.8 (SDI-100), Level 1, 18 gage, 0.042 inch, minimum thickness.
2. Finish: Factory primed, for field finishing.
3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
5. Frames wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
7. Door frames: unless specified as Knock-down, to be continuously fully welded, fill, grind and dress face; continuously back weld casing, stop, soffit and rabbet.

B. Exterior Door Frames: Fully welded.
1. Wind resistant building components tested to the following windstorm or severe weather performance standards:
   a. ANSI A250.13
   b. ASTM E330/E1886/E1996
2. Windstorm Certification Label: Each wind-resistant building component shall bear a certification mark of either Underwriters Laboratories Inc. or Intertek Testing Services/Warnock Hersey.
3. Frames may also be listed as fire door frames tested in accordance with UL 1 OB or UL 1 OC or ITS WH. Frames may be fire rated up to and including three hours, except as noted where glass is installed in a frame.
5. Weatherstripping: Separate, see Section 08710.

C. Interior Door Frames, Non-Fire-Rated: Fully welded type.

D. Interior Door Frames, Fire-Rated: Fully welded type.
1. Fire Rating: Same as door, labeled.

2.6 SPECIAL FUNCTION HOLLOW METAL FRAMES:

A. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.7 ACCESSORY MATERIALS:

A. Glazing: As specified in Section 08800, factory installed.

B. Astragals for Double Doors: Specified in Section 08710.
1. Exterior Doors: Steel, Z-shaped.
2. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.

C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
1. Products:

D. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.

E. Silencers: Resilient rubber or vinyl, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

F. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.8 FRAME ANCHORS:

A. Jamb Anchors:
1. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
2. Windstorm Opening Anchors: Types as tested and required for indicated wall types to meet specified wind load design criteria.
B. Floor Anchors: Floor anchors to be provided at each jamb. Formed from same material as frames, not less than 0.042 inches thick.

2.9 FINISH MATERIALS:

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

2.10 FABRICATION:

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:
1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Louvers: Factory cut openings in door and install louvers into prepared openings where indicated.
4. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gage strap for continuous hinges specified in hardware sets in Section 08710 - Door Hardware.

D. Hollow Metal Frames:
1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops require wider dimensions on glass side of frame.
5. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
6. Continuous Hinge Reinforcement: Provide welded continuous 12 gage straps for continuous hinges specified in hardware sets in Section "Door Hardware".
7. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
8. Mortar Guards: Weld guard boxes to frame at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
9. Electrical Thru-Wiring: Provide hollow metal frames receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on one end to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electric through-wire transfer hardware or wiring harness specified in hardware sets in Sections 08710 - Door Hardware. Wire nut connections are not acceptable.

10. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; including but not limited to, electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in hardware sets in Sections 08710 - Door Hardware.
   a. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts.
   b. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
   c. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Section 08710 - Door Hardware.
   d. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.

11. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

12. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Two anchors per jamb up to 60 inches high.
      2) Three anchors per jamb from 60 to 90 inches high.
      3) Four anchors per jamb from 90 to 120 inches high.
      4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

13. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Section 08710 - Door Hardware.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 08710.
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 Sections.
PART 3 - EXECUTION

3.1 EXAMINATION:
   A. Verify existing conditions before starting work.
   B. Verify that opening sizes and tolerances are acceptable.

3.2 PREPARATION:
   A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
   B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.
   C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
   D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION GENERAL:
   A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
   B. In addition, install fire rated units in accordance with NFPA 80.
   C. Coordinate frame anchor placement with wall construction.
   D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
   E. Coordinate installation of hardware.
   F. Coordinate installation of glazing.
   G. Coordinate installation of electrical connections to electrical hardware items.
   H. Touch up damaged factory finishes.
   I. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
      1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
      2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
      3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
      4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
J. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
   a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

K. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 TOLERANCES:

A. Clearances between Door and Frame: As indicated in ANSI/SDI A250.8 (SDI-100).

B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.5 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.

3.6 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION
SECTION 08305
ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Fire resistive rated and non-rated access doors and frames.

B. Provide ceiling and wall access doors as shown on the drawings.

C. Provide additional access doors where required for access to concealed equipment and ceiling spaces with no other means of access.

1.2 RELATED SECTIONS:

A. Section 09260 - Gypsum Board Systems.

B. Section 09900 - Painting.

C. Division 15 - Mechanical.

D. Division 16 - Electrical.

1.3 REFERENCES:

A. Underwriters Laboratories, Inc. (UL).


1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: Include sizes, types, finishes, scheduled locations, and details of mounting to adjacent work.

C. Shop Drawings: Provide Drawings indicating exact position of all access door units.
   1. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.
   2. Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
   3. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.

1.5 QUALITY ASSURANCE:

A. Single Source Responsibility: Obtain access door and panel units, and frames for entire Project from 1 source and 1 single manufacturer.

B. Size Variations: Obtain Architect's acceptance and approval of manufacturer's standard size units that may vary slightly from sizes indicated on Drawings.
C. Coordination: Provide inserts and anchoring devices that will be built into other Work for installation of access door assemblies. Coordinate delivery with other Work to avoid delay.

1.6 WARRANTY:

A. See Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Warrant materials and workmanship against defects after completion and final acceptance of Work.
   1. Repair defects, or replace with new materials, faulty materials or workmanship developed during the guarantee period at no expense to Owner.
   2. Access Panel Warranty: 1 year from date of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
   1. Approved Manufacturers:

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.
   4. Acudor.
   5. Bilco Co.

C. Substitutions: See Section 01630 - Product Substitutions.

2.2 ACCESS PANELS – GENERAL:

A. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies that units are to be installed in.
   1. Material: Steel.
   2. Style: Exposed frame with door surface flush with frame surface.
      a. In Gypsum Board: Use drywall bead type frame.
   3. Door Style: Single thickness with rolled or turned in edges.
   4. Frames: 16 gage, 0.0598 inch, minimum., welded construction
   5. Heavy Duty Frames: 14 gage, 0.0747 inch, minimum.
   7. Heavy Duty Single Thickness Steel Door Panels: 14 gage, 0.0747 inch, minimum.
   8. Double-Skinned Hollow Steel Door Panels: 16 gage, 0.059 inch, minimum, on both sides and each edge.
   10. Insulation: Non-combustible mineral or glass fiber.
2.3 ACCESS PANELS:

A. Non-rated flush access doors, Babcock-Davis BN series.
   1. Door: Fabricate from 14-gauge cold rolled sheet steel.
      a. BNT - All surfaces - 1 inch flange at perimeter.
      b. BNW - Wallboard surfaces - 22-gauge galvanized drywall bead at perimeter.
      c. BNP - Plaster surfaces - 22-gauge galvanized plaster bead at perimeter.
      d. BPT - Stainless Steel - 1 inch flange at perimeter.
   3. Hinge:
      a. BNT - Concealed pin type, spring loaded to allow for door removal, set to open 175 degrees.
      b. BNW and BNP - Concealed continuous piano hinge.
      c. BPT - Pin hinge
   5. Finish: Polyester powder coat; Paintable. Paint to match surrounding wall finish.
   6. Size(s): As indicated.

B. Non-Insulated Fire Rated Assemblies: Babcock-Davis BU Series. Fire rating as required by applicable code for the fire rated assembly in which they are to be installed.
   1. Provide products listed by ITS (DIR) or UL (FRD) as suitable for the purpose indicated.
   2. Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.
   4. Door: 14-gauge cold rolled steel
      a. Door and frame assembly shall comply with NFPA 80.
   5. Frame: 16-gauge cold rolled steel
      a. BUT: 1" flange for all surfaces
      b. BUW: 22-gauge galv. drywall corner bead
      c. BUP: 22-gauge galv. plaster casing bead
   6. Hinge:
      a. BUT: Flush continuous piano
      b. BUP: Concealed pin
      c. BUW: Concealed pin
   7. Latch: Knurled knob/key operated latch bolt.
   8. Finish: Polyester powder coat; Paintable.
   9. Size: As indicated on the drawings.
  10. Hardware:
      b. Hinges for Non-Fire-Rated Units: Continuous pivoting rod hinge.
      c. Lock: Screw driver slot for quarter turn cam lock. Provide additional cam locks as required by the Manufacturer to keep the door closed flush.
      d. Number of Locks/Latches Required: As recommended by the manufacturer for the size of the unit.
  11. Gasketing: Extruded neoprene, around the perimeter of the door panel.

C. Recessed access panels, Babcock-Davis BR series:
   1. Door: Fabricate from 16-gauge cold rolled sheet steel recessed 5/8" depth pan for in-fill of material to match surrounding surface.
   2. Frame: Fabricate from 16-gauge cold rolled sheet steel of configuration to suit material application.
      a. BRW - Wallboard surfaces - 22-gauge galvanized drywall bead at perimeter.
      b. BRP - Plaster surfaces - 22-gauge galvanized plaster bead at perimeter.
      c. BRA - Acoustical surfaces - no surface frame.
   3. Size: As indicated.
D. Babcock-Davis BRU Series for tiled vertical surfaces.
   1. Door: 14-ga bonderized/galvanized steel.
   2. Frame: 16-ga bonderized/galvanized steel.
   3. Hinge: Cabinet type.
   4. Latch: Flush key operated lock.
   5. Finish: None.

PART 3 - EXECUTION

3.1 EXAMINATION:
   A. Verify locations and sizes of access panels required.
   B. Verify rough openings for door and frame are correctly sized and located.
   C. Verify location and orientation of equipment or controls requiring access.
   D. Beginning of installation means acceptance of existing conditions.
   E. Verify mechanical and electrical requirements for ceiling or wall access panels.

3.2 INSTALLATION:
   A. Install units in accordance with the manufacturer's instructions.
   B. Install fire rated units in accordance with requirements established by the rating agency.
   C. Install frame plumb and level in wall and ceiling openings.
   D. Install ceiling mounted frames square and parallel with adjacent walls and on axis of room or space. Center openings in corridor ceilings unless noted otherwise.
   E. Position to provide convenient access to concealed work requiring access.
   F. Secure rigidly in place in accordance with manufacturer's instructions.

3.3 ADJUST AND CLEAN:
   A. Adjust panel after installation for proper operation.
   B. Remove and replace panels or frames that are warped, bowed, or damaged.

END OF SECTION
SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Mechanical and electrified door hardware for:
   1. Swinging doors.

B. Electronic access control system components, including:
   1. Electronic access control locksets and electric strikes.
   2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

C. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
   1. Windows
   2. Cabinets (casework), including locks in cabinets
   3. Signage
   4. Toilet accessories
   5. Overhead doors

D. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.
   1. Lock cylinders to be installed under other Sections.
   2. Permanent lock cores to be installed by Owner.

1.2 RELATED SECTIONS:

A. Section 07900 - Joint Sealants: for sealant requirements applicable to threshold installation specified in this section.

B. Section 08111 – Hollow Metal Doors and Frames.

C. Section 09900 – Painting and Coatings: for touchup finishing or refinishing of existing openings modified by this section.

D. Division 16 sections for connections to electrical power system and for low-voltage wiring.

E. Division 16 sections for coordination with other components of electronic access control system.

1.3 REFERENCES:


E. NFPA 105 - Smoke and Draft Control Door Assemblies.
G. State Building Codes, Local Amendments.
I. UL 10B - Fire Test of Door Assemblies.
J. UL 10C - Positive Pressure Test of Fire Door Assemblies.
K. UL 1784 - Air Leakage Tests of Door Assemblies.
L. UL 305 - Panic Hardware.
M. ADA - Americans with Disabilities Act.
N. DHI - Door and Hardware Institute.
   1. Sequence and Format for the Hardware Schedule.
   2. Recommended Locations for Builders Hardware.
O. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties.

1.4 SYSTEM DESCRIPTION:
A. Performance Requirements: The Manufacturer or Authorized Distributor shall confirm that there is an established local agency which stocks a full complement of parts and offers service during normal working hours for the finish hardware to be furnished and that the agency will supply parts without delay and at reasonable cost.
B. Furnish hardware items of proper design for use in doors and frames of the thicknesses, profile, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information in the Contract Documents.

1.5 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. General:
   1. Submit in accordance with Conditions of Contract and Division 01 requirements.
   2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
   3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION“ article, herein.
C. Product Data: Product data including manufacturers’ technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
D. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   1. Wiring Diagrams: For power, signal, and control wiring and including:
      a. Details of interface of electrified door hardware and building safety and security systems.
b. Schematic diagram of systems that interface with electrified door hardware.
c. Point-to-point wiring.
d. Risers.

E. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
   a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

F. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
   1. Door Index; include door number, heading number, and Architects hardware set number.
   2. Opening Lock Function Spreadsheet: List locking device and function for each opening.
   3. Type, style, function, size, and finish of each hardware item.
   4. Name and manufacturer of each item.
   5. Fastenings and other pertinent information.
   6. Location of each hardware set cross-referenced to indications on Drawings.
   7. Explanation of all abbreviations, symbols, and codes contained in schedule.
   8. Mounting locations for hardware.
   9. Door and frame sizes and materials.
  10. Name and phone number for local manufacturer’s representative for each product.
  11. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
     a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

G. Key Schedule:
   1. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system’s function, key symbols used and door numbers controlled.
   2. Use ANSI A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   3. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   4. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   5. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
   6. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   7. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

H. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
I. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 16 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

J. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product Certificates for electrified door hardware, signed by manufacturer:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
   a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
   b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
   c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
5. Warranty: Special warranty specified in this Section.

K. Closeout Submittals:

1. Contract Closeout Submittals: Comply with Section 01770 including specific requirements indicated.
2. Operating and Maintenance Data: Submit in accordance with Section 01782. Provide Owner with Manufacturer's parts list and maintenance instructions for each type of hardware supplied and necessary wrenches and tools required for proper maintenance of hardware:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Name, address, and phone number of local representative for each manufacturer.
   d. Parts list for each product.
3. Final approved hardware schedule, edited to reflect conditions as-installed.
4. Final keying schedule
5. Copies of floor plans with keying nomenclature
6. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
7. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
1.6 QUALITY ASSURANCE:

A. Product Substitutions: Comply with product requirements stated in Section 01630 and as specified herein.
   1. Where specific manufacturer’s product is named and accompanied by “No Substitute,” including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
      a. Where no additional products or manufacturers are listed in product category, requirements for “No Substitute” govern product selection.
   2. Where products indicate “acceptable substitute” or “acceptable manufacturer”, provide product from specified manufacturers, subject to compliance with specified requirements and “Single Source Responsibility” requirements stated herein.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
   1. Warehousing Facilities: In Project’s vicinity.
   2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
   3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer’s standard units in assemblies similar to those indicated for this Project.
   4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
      a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

C. Manufacturers Qualifications: Engage qualified manufacturers with a minimum ten (10) years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

D. Installer Qualifications: Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum five (5) years documented experience installing both standard and electrified builders hardware 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.

E. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
   2. Can provide installation and technical data to Architect and other related subcontractors.
   3. Can inspect and verify components are in working order upon completion of installation.
   5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

F. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
   1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
   2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
G. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

H. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

I. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

J. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

K. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
1. NFPA 70 “National Electrical Code”, including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
   a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
   b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
   c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
3. NFPA 101: Comply with the following for means of egress doors:
   a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
   b. Thresholds: Not more than 1/2 inch high.
4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40” above sill) or UL-10C.
   a. Test Pressure: Positive pressure labeling.

L. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
2. Maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

1.7 ADMINISTRATIVE REQUIREMENTS:

A. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

B. Convey Owner’s keying requirements to manufacturers.

C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

D. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
   2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      b. Preliminary key system schematic diagram.
      c. Requirements for key control system.
      d. Requirements for access control.
      e. Address for delivery of keys.

E. Pre-installation Conference: Conduct conference at Project site
   1. Review and finalize construction schedule and verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Inspect and discuss preparatory work performed by other trades.
   3. Inspect and discuss electrical roughing-in for electrified door hardware.
   4. Review sequence of operation for each type of electrified door hardware.
   5. Review required testing, inspecting, and certifying procedures.

F. Coordination Conferences:
   1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
      a. Attendees: Door hardware supplier, door hardware installer, Contractor.
      b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
   2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
      a. Attendees: Owner’s access control company — Vegas Valley Locking Systems, electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
      b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.
1.8 COORDINATION:

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical Requirements: Coordinate all electrical requirements for doors and frames. Make provisions for installation of electrical items so that wiring can be readily removed and replaced.
   1. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
   2. Provide cutouts and reinforcements required for metal door frame to accept electric components.
   3. Frame with Electrical Hinges: Weld UL listed grout guard cover box welded over center hinge reinforcing. Top or bottom hinge locations are not permitted.
   4. Provide cutouts and reinforcements required to accept security system components.
   5. Coordinate with Section 08710 for electrified hardware items.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

F. Direct shipments not permitted, unless approved by Contractor.

1.9 DELIVERY, STORAGE, AND HANDLING:

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
   1. Deliver each article of hardware in manufacturer’s original packaging.

C. Project Conditions:
   1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
   2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:
   1. Promptly replace products damaged during shipping.
   2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
   3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
F. Deliver keys and permanent cores to: JJ Hall, Lead Locksmith, UNLV Lock Shop by registered mail or overnight package service.

1.10 MAINTENANCE:

A. Extra Materials:
   1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
      a. Door Hardware: Coordinate with UNLV Lock Shop
      b. Electrical Parts: Coordinate with UNLV Lock Shop

B. Maintenance Tools:
   1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

C. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner’s continued adjustment, maintenance, and removal and replacement of door hardware.

D. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

1.11 WARRANTY:

A. See Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
      a. Closers:
         1) Mechanical: 30 years for LCN 4000
         2) Electrified: 2 years.
      b. Automatic Operators: 1 year
      c. Exit Devices:
         1) Mechanical: 3 years.
         2) Electrified: 1 year.
      d. Locksets:
         1) Mechanical: 7 years.
         2) Electrified: 1 year.
      e. Continuous Hinges: Lifetime warranty
      f. Key Blanks: Lifetime
   2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”
1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products from manufacturers indicated as “Acceptable Manufacturer” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

<table>
<thead>
<tr>
<th>Item</th>
<th>Scheduled Manufacturer</th>
<th>Acceptable Manufacturer</th>
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</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Ives (IVE)</td>
<td>Hager, Stanley</td>
</tr>
<tr>
<td>Continuous Hinges</td>
<td>Ives (IVE)</td>
<td>Markar, Stanley</td>
</tr>
<tr>
<td>Electric Power Transfer</td>
<td>Von Duprin (VON)</td>
<td>ABH,</td>
</tr>
<tr>
<td>Flush Bolt</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
</tr>
<tr>
<td>Surface Bolts</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
</tr>
<tr>
<td>Coordinators</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
</tr>
<tr>
<td>Locksets &amp; Deadlocks</td>
<td>Schlage (SCH)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Aluminum Door Locks – Narrow Style</td>
<td>Medeco Keymark (MED)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Sliding Door Locks</td>
<td>Adams Rite (ADA)</td>
<td>As pre-approved</td>
</tr>
<tr>
<td>Pocket Door Locks</td>
<td>Accurate (ACC)</td>
<td>As pre-approved</td>
</tr>
<tr>
<td>Exit Devices &amp; Mullions</td>
<td>Von Duprin (VON)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Electronic Access Control – Hardwired</td>
<td>Millennium</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Access Control Readers</td>
<td>Schlage Electronics (SCE)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Access Control Credentials</td>
<td>Schlage – Electronic (SCE)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Electric Strikes</td>
<td>Schlage – Electronic (SCE)</td>
<td>HES</td>
</tr>
<tr>
<td>Magnetic Locks - Surface Type</td>
<td>HES (HES)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Magnetic Locks - Shear Type</td>
<td>Schlage Electronics (SCE)</td>
<td>Securitron</td>
</tr>
<tr>
<td>Cylinders &amp; Keying</td>
<td>Medeco Keymark (MED)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Door Closers</td>
<td>LCN (LCN)</td>
<td>No Substitute</td>
</tr>
<tr>
<td>Closer/Holder Unit</td>
<td>LCN (LCN)</td>
<td>No Substitute,</td>
</tr>
<tr>
<td>Electro-Mechanical Automatic Operators</td>
<td>Stanley (STN)</td>
<td>LCN Sr. Swing</td>
</tr>
<tr>
<td>Protection Plates</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
</tr>
<tr>
<td>Overhead Stops</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
</tr>
<tr>
<td>Thresholds &amp; Weatherstrip</td>
<td>Ives (IVE)</td>
<td>Pemko, Zero</td>
</tr>
<tr>
<td>Silencers</td>
<td>Ives (IVE)</td>
<td>Pemko, Zero</td>
</tr>
<tr>
<td>Magnetic Holders</td>
<td>LCN (LCN)</td>
<td>Hager, Rockwood</td>
</tr>
<tr>
<td>Latch Protector</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
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<tr>
<td>Sliding Door Hardware</td>
<td>Ives (IVE)</td>
<td>Hager, Rockwood</td>
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D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.
2.2 EXISTING MATERIALS:

A. Where existing door hardware is indicated to be removed and reinstalled:
   1. Carefully remove door hardware and components.
   2. Clean, protect and store existing door hardware in accordance with storage and handling requirements specified herein.
   3. Reinstall in accordance with installation requirements for new door hardware.

2.3 MATERIALS:

A. Fasteners
   1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
   2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
   3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
   4. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
   1. Use materials which match materials of adjacent modified areas.
   2. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
   1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
   1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
   2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
   3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.

2.4 HINGES:

A. Provide five-knuckle, ball bearing hinges.
   1. Manufacturers and Products:

B. Requirements:
   1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
      a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
      b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
   2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
      a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
      b. Interior: Heavy weight, steel, 5 inches (127 mm) high
3. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high

4. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

5. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.

6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

8. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.

10. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.

11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.5 CONTINUOUS HINGES:

A. Stainless Steel:
   1. Manufacturers:
      a. Scheduled Manufacturer: Ives
      b. Acceptable Manufacturers: Markar, Stanley
   2. Requirements:
      a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
      b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
      c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
      d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
      e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
      f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
      g. Install hinges with fasteners supplied by manufacturer.
      h. Provide hinges with symmetrical hole pattern.

B. Cold-Rolled Steel:
   1. Manufacturers:
      a. Scheduled Manufacturer: Ives
      b. Acceptable Manufacturers: Markar, Stanley
2. Requirements:
   a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
   b. Provide pin and barrel continuous hinges fabricated from type 1012 cold rolled steel.
   c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
   d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
   e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
   f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
   g. Install hinges with fasteners supplied by manufacturer.
   h. Provide hinges with symmetrical hole pattern.

C. Aluminum Geared:
   1. Manufacturers:
      a. Scheduled Manufacturer: Ives.
   2. Requirements:
      a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.
      b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
      c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
      d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
      e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
      f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
      g. Install hinges with fasteners supplied by manufacturer.
      h. Provide hinges with symmetrical hole pattern.

2.6 ELECTRIC POWER TRANSFER:

A. Manufacturers:
   1. Scheduled Manufacturer: Von Duprin
   2. Acceptable Manufacturers: ABH

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer’s template and UL requirements, unless interference with operation of door or other hardware items.

2.7 FLUSH BOLTS:

A. Manufacturers:
   1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:
1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.8 SURFACE BOLTS:

A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:
1. Surface bolts to have 1” throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8’ in height.

2.9 COORDINATORS:

A. Manufacturers:
1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Hager, Rockwood

B. Requirements:
1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.10 ALUMINUM DOOR LOCKS – WIDE STYLE:

A. Manufacturer and Product: Adams Rite 4900 series X 4568/9 Lever or 4590/1 Paddle

B. Requirements:
1. Provide narrow style aluminum door locks as specified. Cylinders: Refer to “KEYING” article, herein.
2. Provide locks with [1-1/8 inches (29 mm)][1-1/2 inches (38 mm)] backset as required for door detail with full 5/8 inch (16 mm) throw latchbolt.
3. Provide manufacturer’s standard strikes unless extended lip strikes are necessary to protect trim.

2.11 CYLINDRICAL LOCKS – GRADE 1:

A. Manufacturers and Products:
1. Scheduled Manufacturer and Product: Schlage ND Series

B. Requirements:
1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to “KEYING” article, herein.
2. If Required- Provide cylindrical locks with classroom security function with an inside indicator that provides clear direction for users to safely and quickly secure the room.
3. Provide locksets able to withstand 1500 inch pounds of torque applied to locked outside lever without gaining access per ANSI A156.2 Abusive Locked Lever Torque Test and cycle tested to 3 million cycles per ANSI A156.2 Cycle Test.

4. Provide solid steel rotational stops to control excessive rotation of lever.

5. Provide completely re-functional lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.

6. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.

7. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.

8. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.

9. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

10. Provide electrically operated options as scheduled in the hardware sets.

11. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
   b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.12 EXIT DEVICES OPTION: When requested to specify Von Duprin and/or the concealed cable device No Substitute.

A. Manufacturer and Product: Von Duprin 99/33 series OPTION 98/35 series, No Substitute

B. Requirements:
   1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, [OPTION for specific compliant products/applications: UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4,] and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to “KEYING” article, herein.
   2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
   3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
   4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
   5. Provide rim devices with a dual cylinder or inside thumb turn cylinder option with a visual security indicator that identifies the trims locked/unlocked status of the door from the inside of the room. Indicator in unlocked state presents a 1/2 inch x 1/2 inch white metal flag with black icon at top of device head. Indicator in locked state has no flag present. Provide rim devices without the dual cylinder or inside thumb turn cylinder option capable of being retrofitted with the visual security indicator.
   6. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
   8. XP 98/99 only: Latchbolt, Rim Exit Devices: Non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress.
   9. 98/9949 and/or 33/3549A only: Concealed Vertical Cable Exit Devices: Cable-actuated concealed vertical latch system in two-point and less bottom latch (LBL) configurations. Vertical rods not permitted.
      a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-coded to latches and center slides. Conduit and core wire ends snap into latch and center slides without use of tools.
      b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper-infilitrated steel, with molybdenum disulfide low friction coating.
c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
e. Product Cycle Life: 1,000,000 cycles.
f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
g. Latch release does not require separate trigger mechanism.
h. Cable and latching system characteristics:
   1) Assembled prior to being installed in door.
   2) Installed in door as complete assembly.
   3) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
   4) Connected to exit device at single attachment point.
   5) Bottom latch height adjusted from single point, after system is installed and connected to exit device, while door is hanging
   6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
   7) System may be removed while door is hanging.
   8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
   9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.
   10. Provide exit devices with manufacturer’s approved strikes.
   11. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
   12. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
   13. Provide hex-key dogging at non-fire-rated exit devices, unless specified less dogging.
   14. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
   15. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
   a. Lever Style: Match lever style of locksets.
   b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
   16. Provide UL labeled fire exit hardware for fire rated openings.
   17. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
   18. Provide electrified options as scheduled in the hardware sets.

2.13 ACCESS CONTROL READER:

A. Manufacturers and Products:
B. Requirements: Read Only Multi-technology Contactless reader

1. Access control card readers shall be as manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications shall not be acceptable.

2. Multi-technology contactless reader shall read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. The multi-technology contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz Proximity and 13.56 MHz contactless smart cards by providing:
   a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
   b. A migration platform to upgrade from the most popular 125 kHz proximity technologies to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
   c. Guaranteed compatibility to read all standard data formats ensuring card-to-reader interoperability in multi-location installations and multi-card/reader populations.
   d. Secure access control data exchange between the smart card and the reader utilizing diversified keys and mutual authentication sequences.
   e. Universal compatibility with most access control systems.
   f. Ease of installation through industry standard wiring methods.
   g. Compatibility with legacy 125 KHz proximity access control formats (all standard formats up to 37 bits, including HID Corporate 1000 formats).
   h. Optimal read range and read speed for increased access control throughput.
   i. Global availability.
   j. Product construction suitable for both indoor and outdoor applications.
   k. Customizable behavior for indicator lights and beeper.

3. Multi-technology contactless reader shall comply with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance:
   a. ISO 14443

4. Multi-technology contactless reader shall be configurable to read 13.56 MHz data simultaneously from the following cards (multiple credential support based on reader configuration):
   a. Secure support - Mifare DESFire EV1 with PACSA, Mifare Classic, FIPS 201 PIV Credential.
   b. UID/CSN Support – DESFire Classic V0.06, HID iClass, ISOX (my-d).

5. Multi-technology contactless reader shall be configurable to read data from any compatible 125 kHz technology simultaneously with 13.56 MHz data. Compatible 125 kHz technologies include:
   a. XCEEDID/Schlage/HID Prox (format in the card – formats up to 37-bits supported).
   b. AWID PROX (SAME AS LENEL PROX - format in the card – formats up to 42-bits).
   c. GE PROX - two possible format options.

6. Multi-technology contactless reader shall provide the ability to read card access data stored in the secure access control sector/application area of the ISO 14443 XceedID MIFARE or MIFARE DESFire EV1 card.

7. The Multi-technology contactless reader shall be configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Compatibility shall be provided for the following key structure options:
   a. Compatibility with the default manufacture’s key structure to ensure convenient off the shelf compatibility with manufacture’s cards and readers.
   b. Compatibility with custom keys managed by manufacturer which provide a site-specific, unique, protected key structure.
   c. Compatibility with high security customer managed custom keys.
8. The Multi-technology contactless reader shall be configurable to provide compatibility with all standard Prox formats up to 37 bits (including Corporate 1000®).
9. Multi-technology contactless reader shall allow the reader firmware to be upgraded in the field without the need to remove the reader from the wall through the use of factory-provided device.
10. Multi-technology contactless reader shall be suitable for global deployment by meeting worldwide radio and safety regulatory compliance including:
   a. FCC Certification (US)
   b. CE (EU)
   c. C-tick (Australia, New Zealand)
   d. R&TTE Directive (15EU)
   e. UL294 (US)
   f. ULC-S319
   g. IC (Canada)
   h. FIPS201 / PIV I
   i. IP65
11. Multi-technology contactless reader shall be fully compliant with Restriction of Hazardous Substances directive (RoHS) restricting the use of specific hazardous materials found in electrical and electronic products.
12. Multi-technology contactless reader shall provide universal compatibility with most access control systems by outputting card data in compliance with the SIA AC-01 Wiegand standard.
13. Multi-technology contactless reader shall allow for secure installation practices through mounting methods utilizing tamper resistant screws.
14. Multi-technology contactless reader shall provide the ability to transmit an alarm signal via and integrated optical tamper switch if an attempt is made to remove the reader from the wall. The tamper switch shall be programmable to provide a selectable action to provide a selectable action compatible with various tamper communication schemes provided by access control panel manufacturers. The selectable action shall include one of the following:
   a. The reader open collector line changes from a high state (5V) to a low state (Ground).
   b. If utilizing OSDP Protocol reader shall report a tamper condition via RS485.
15. Multi-technology contactless reader shall provide the ability for mounting to standard electrical boxes through the use of universal international mounting holes.
16. Multi-technology contactless reader shall be provided with a full potted assembly.
17. Multi-technology contactless reader shall be provided with a quick connect wire harness.
18. The Multi-technology contactless reader shall provide customizable reader behavior options either from the factory, or defined in the field through the use of pre-configured command cards. Reader behavior programming options shall include:
   a. LED & Audio configurations.
   b. Ability to disable reading of specific card technologies or frequencies.
   c. ISO 14443/15693 CSN output configuration.
   d. Wiegand output spacing and timing.
19. Multi-technology contactless reader shall provide the following programmable audio/visual indication:
   a. An audio beeper shall provide tone sequence to signify: access granted, access denied, power up, and diagnostics.
   b. A light bar shall provide clear visual status (red/green/amber).
20. Multi-technology contactless reader shall be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:
   a. Operating voltage: 5 – 16 VDC, reverse voltage protected. Linear power supply recommended.
   b. Current requirements: 160 mA DC, 195 mA PEAK @ 12 VDC.
21. Multi-technology contactless reader shall meet the following physical specifications:
   a. Dimensions: 5.1” x 3.25” x 0.83” (12.9 cm x 8.3 cm x 2.1 cm).
   b. Weight: 9.6 oz. (272.15 g).
   c. Material: UL94 Polycarbonate.
   d. Plastics: Consist of three-piece design with mounting plate, potted case and aesthetic cover.
   e. Color: Black, Gray, Brown or Cream as approved by the project architect.

22. Multi-technology contactless reader shall meet the following environmental specifications:
   a. Operating temperature: -31 to 151 degrees F (-35 to 67 degrees C)
   b. Operating humidity: 5% to 95% relative humidity non-condensing.
   c. Weatherized design suitable to withstand harsh environments.
      1) Certified rating of IP65.

23. Multi-technology contactless reader cabling requirements shall be:
   a. Cable distance: (Wiegand): 500 feet (150m).
   b. Cable type: 5-conductor #22 AWG.
   c. Standard reader termination: 18” (0.5m) wire harness.

2.14 ELECTRIC STRIKES:

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: SCE

B. Requirements:
   1. Provide electric strikes designed for use with type of locks shown at each opening.
   2. Provide electric strikes UL Listed as burglary-resistant.
   3. Where required, provide electric strikes UL Listed for fire doors and frames.
   4. Provide fail-secure type electric strikes, unless specified otherwise.
   5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

2.15 CYLINDERS:

A. Manufacturers:
   1. Scheduled Manufacturer: Medeco KeyMark.
   2. Coordinate keying requirements with JJ Hall, Locksmith Lead, UNLV Lock Shop.

B. Small Format IC cylinders distributed throughout the Project as indicated.
   1. Security: dual-locking cylinder with interchangeable core requiring restricted, patented keyway. Medeco KeyMark Keyway

2.16 CYLINDERS OPTION: for EXISTING key system:

A. Manufacturer: Medeco
   1. Scheduled Manufacturer: KeyMark, No Substitute

B. Requirements: Provide cylinders/cores complying with the following requirements.
   1. Cylinders/cores compliant with ANSI/BHMA A156.5; latest revision, Section 12. Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer’s series as indicated.

C. Manufacturer-keyed permanent cylinders/cores, configured into existing keying system per “KEYING” article herein. Must coordinate keying with JJ Hall, Locksmith Lead, UNLV Lock Shop.

D. Nickel silver bottom pins.
   1. Identification:
E. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication “Keying Systems and Nomenclature” for identification. Blind code marks shall not include actual key cuts.

F. Identification stamping provisions must be approved by the Architect and Owner.

G. Failure to comply with stamping requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   1. Forward cylinders/cores to Owner, separately from keys, by means as directed by Owner.
   2. Exterior Doors: Security cylinders with interchangeable cores requiring use of restricted, patented keys incorporating dual-locking mechanism with 5 interlocking pins to check for patented key features.
   3. Doors Designated as High Security: High security cylinders with permanent cores requiring use of restricted, patented keys incorporating dual-locking mechanism with 5 interlocking pins to check for patented key features; compliant with UL437 for drill and pick resistance; and integrated into exterior keying system without change to bitting combinations.

2.17 EXTERIOR EMERGENCY KEY CABINETS:

A. Furnish and install recessed mounted exterior emergency key cabinets equivalent to Rapid Entry System "Hinged Door Series 3200 Knox-Box" as manufactured by Knox Co., Phoenix, AZ, on exterior walls adjacent to the front entrances as directed by local Fire Department.
   1. Exterior emergency key cabinets shall be approximately 4"H x 5" W x 3-3/4" D capable of holding up to 10 keys and access cards in interior compartment, lid steel housing 100% welded construction.
   2. High security UL listed double-action rotating tumblers and hardened steel pins accessed by a biased cut key. Lock shall have 1/8" thick stainless steel dust cover with tamper seal mounting capability. Provide 4 keys to each cabinet master-keyed to the local Fire Department keying system.
   3. Dead bar protected stainless steel hinge.
   4. 1/2" thick steel door with three-bolt latch and weather resistant door gasket.
   5. Hinged door shall allow single hand operation.
   6. Provide UL listed alarm tamper switch.
   7. Provide matching recess mounting kits (RMK) with 7" x 7" face flange for recess mounting into the concrete or masonry walls.

B. Finish Color: black.

2.18 DOOR CLOSERS OPTION:

A. Manufacturer and Product: LCN 4040XP series. No Substitute

B. Requirements:
   1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
   2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
   3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
   4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
   5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
   6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.19 ELECTRO-MECHANICAL AUTOMATIC OPERATORS:

A. Manufacturers and Products:

B. Requirements:
   1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI A156.19.
      a. Opening: Powered by DC motor working through reduction gears.
      b. Closing: Spring force.
      d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
      e. Cover: Aluminum.
   2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
   3. Provide drop plates, brackets, or adapters for arms as required to suit details.
   4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
   5. Provide key switches, with LED’s, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to “KEYING” article, herein.
   6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
   7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.20 DOOR TRIM:

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.
B. Requirements:
1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.21 PROTECTION PLATES:
A. Manufacturers:
   1. Scheduled Manufacturer: Ives.
B. Requirements:
   1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
   2. Sizes of plates:
      a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
      b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
      c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.22 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS:
A. Manufacturers:
   1. Scheduled Manufacturers: Glynn-Johnson
   2. Acceptable Manufacturers: Hager, Rockwood
B. Requirements:
   1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
   2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
   3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
   4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.
2.23 DOOR STOPS AND HOLDERS:

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.

B. Provide door stops at each door leaf:
   1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
   2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
   3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.24 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING:

A. Manufacturers:
   1. Scheduled Manufacturer: National Guard Products.

B. Requirements:
   1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
   2. Size of thresholds:
      a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
      b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
   3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.25 SILENCERS:

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.

B. Requirements:
   1. Provide "push-in" type silencers for hollow metal or wood frames.
   2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
   3. Omit where gasketing is specified.

2.26 MAGNETIC HOLDERS:

A. Manufacturers:
   1. Scheduled Manufacturer: LCN.

B. Requirements:
   1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordination projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Wire magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.
2.27 LATCH PROTECTORS:

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.

B. Provide latch protectors of type required to function with specified lock.

2.28 FINISHES:

A. Finish: BHMA 626/652 (US26D); except:
   1. Hinges at Exterior Doors: BHMA 630 (US32D)
   2. Continuous Hinges: BHMA 630 (US32D)
   4. Protection Plates: BHMA 630 (US32D)
   5. Overhead Stops and Holders: BHMA 630 (US32D)
   6. Door Closers: Powder Coat to Match
   7. Wall Stops: BHMA 630 (US32D)
   8. Latch Protectors: BHMA 630 (US32D)
   9. Weatherstripping: Clear Anodized Aluminum
  10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

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

3.2 PREPARATION:

A. Where on-site modification of doors and frames is required:
   1. Remove existing hardware being replaced, tag, and store according to contract documents.
   2. Field modify and prepare existing door and frame for new hardware being installed.
   3. When modifications are exposed to view, use concealed fasteners, when possible.
   4. Prepare hardware locations in accordance with:
      a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
      b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
      c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.
3.3 INSTALLATION:

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
   2. Custom Steel Doors and Frames: HMMA 831.

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as indicated in keying section.

J. Wiring: Coordinate with Division 16, ELECTRICAL sections for:
   1. Conduit, junction boxes and wire pulls.
   2. Connections to and from power supplies to electrified hardware.
   3. Connections to fire/smoke alarm system and smoke evacuation system.
   4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
   5. Testing and labeling wires with Architect’s opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
   1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL:

A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
   1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING:

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
   2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION:

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.
3.7 DEMONSTRATION:
A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE:
A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
B. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.
C. Do not order material until submittal has been reviewed, stamped, and signed by Architect's door hardware consultant.
D. See door schedule in drawings for hardware set assignments.
E. Manufacturers and their abbreviations used in this schedule:

3.9 DOOR HARDWARE SCHEDULE:

HW SET 01 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, CARD READER, AND WIRING BY VVLS.
For use on mark/door #(s):
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WELDED ASTRAGAL PROVIDED BY DOOR MFG.
### HW SET 02 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, AND WIRING BY OWNER
SUPPLIED SECURITY CONTRACTOR-VVLS.

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### HW SET 03 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, AND WIRING BY OWNER
SUPPLIED SECURITY CONTRACTOR-VVLS.

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SOUND SEAL ON HEAD AND JAMBS

HW SET 05.1 - POWER SUPPLY, ELECTRIC STRIKE, DOOR CONTACT, AND WIRING, BY OWNER
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SOUND SEAL ON HEAD AND JAMBS

HW SET 06

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END OF SECTION
SECTION 08800
GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Provide all Glass indicated on drawings or specified herein, including all labor, materials, equipment, and services necessary to complete the glass and glazing, including, but not limited to, the following:
   1. Glass and glazing for hollow metal doors.
   2. Light-filtering film for interior glazing applications.
   4. Attic stock of glass and glazing materials, if required

1.2 REFERENCES:

C. AAMA GAG-1, Glass and Glazing.
D. AAMA CWS-12, Structural Properties of Glass.
E. AAMA 807.1 Glazing Tapes.
H. ASTM E773 - Test Method for Accelerated Weathering of Sealed Insulating Glass Units.
I. ASTM E774 - Specification for Classification of the Durability of Sealed Insulating Glass Units.
   1. GANA (GM) - GANA Glazing Manual
   2. GANA (SM) - FGMA Sealant Manual

1.3 RELATED SECTIONS:

A. Section 08111 – Hollow Metal Doors and Frames.
B. Section 10801 - Toilet and Bath Accessories.
1.4 PERFORMANCE REQUIREMENTS:

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the in-service conditions.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: For each glass product and glazing material indicated provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements, rating requirements and special conditions applicable to fire and safety glazing ratings.

C. Shop Drawings
   1. Submit shop drawings showing details of each type of glazing system indicating sizes, shapes, material and quantity. Show details indicating sealant thickness and profile, bite on glass, glass edge clearance, depth of rabbet and thickness of glass. Identify gasket materials, side spacer blocks, and setting blocks. Details shall be full scale and fully drawn, not outlined.

D. Samples: For the following products, submit samples in the form of 12-inch- square glass.
   1. Each color of tinted float glass.
   2. Coated vision glass.
   3. Insulating glass for each designation indicated.
   4. Mirror glass.
   5. Spandrel panels.

E. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE:

A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

   1. Where safety glazing units are specified for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide units that comply with Category II requirements
   2. For safety glazing lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category II requirements.
D. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

E. Submit manufacturer's certified identification, showing strength, grade, thickness, type and quality for each type of glass used. Mark tempered, heat strengthened and laminated glass with permanent identification labels.

1.7 PROJECT CONDITIONS:

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.8 WARRANTY:

A. See Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Provide ten (10) year manufacturer's warranty under provisions of the front end and/or general conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/FABRICATORS:

A. Float Glass Manufacturers
   1. Guardian Industries Corp.
   2. Pilkington
   3. PPG
   4. Saint Gobain
   5. Visteon

B. Float Glass Fabricators - Tempered, Non-Coated, Insulated
   1. ACI
   2. AFGD
   3. Hehr Glass
   4. Northwestern Industries
   5. Oldcastle Glass

C. Light-filtering film:
   1. Light Gard; subsidiary of Solar Graphics "Rose/Chocolate (RC-3)".

D. Substitutions: See Section 01630 - Product Substitutions.

2.2 FLAT GLASS MATERIALS

A. Type 1: Clear Glass: ASTM C1036, Type 1, Class 1, Quality: q5-Glazing B.


C. Type 3: HS Glass: Heat Strengthened, ASTM C1048, HS, Type 1, Class 1 or 2, Quality: q5-Glazing B.

E. Type 4: Laminated Glass: Meet requirements of ASTM C1172 Standard for Laminated
Architectural Flat Glass

1. Glass: ASTM C1036, Type 1, Class 1, q5-Glazing B Quality.

F. General Identification Requirements For Glass

1. Identification. Each pane shall bear the manufacturer’s mark designating the type and thickness of the glass or glazing material.
2. The identification shall not be omitted unless approved and an affidavit is furnished by the glazing contractor certifying that each light is glazed in accordance with approved construction documents that comply with the provisions of IBC.
3. Each pane of tempered glass, except tempered spandrel glass, shall be permanently identified by the manufacturer. The identification mark shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that, once applied, cannot be removed without being destroyed.
4. Tempered spandrel glass shall be provided with a removable paper marking by the manufacturer.
5. Safety glazing shall be identified as specified elsewhere in this section.
6. Bow and warp. Glass manufacturer shall provide a QC program to detect and discard any lites which exceed the following tolerances:
   a. Glass that has any deviation from flat (bow) of 0.15% of the shortest glass dimension.
   b. Where the heat treating process results in essentially parallel ripples or waves, the deviation from flatness at any peak shall not exceed 0.0051”, and the difference between adjacent peaks shall not exceed 0.0031”.
   c. Where bow tolerance and wave tolerance differ, the stricter requirements shall govern.
   d. Direction of ripples shall be horizontal, consistent and in conformance with the architectural design.

2.3 SAFETY GLAZING:

A. Individual glazed areas, including glass mirrors, in hazardous locations as defined in IBC shall comply with impact test requirements.

B. Impact test. Where required by IBC glazing shall be tested in accordance with CPSC 16 CFR 1201. Glazing shall comply with the test criteria for Category I or II as listed in IBC.

C. Identification of Safety Glazing.
   1. Each pane of safety glazing installed in hazardous locations shall be identified by a manufacturer’s designation specifying who applied the designation, the manufacturer or installer and the safety glazing standard with which it complies, as well as the information specified for general glass.
   2. The designation shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that once applied, cannot be removed without being destroyed.

2.4 GLASS TYPES:

A. Glass Type 1: RC3 - Double-Pane: 1/4" red FT glass.

2.5 LIGHT-FILTERING FILM:

A. RC-3 double-pane tempered safety glass is constructed of two 1/8”, “combinations of tempered glass. Surface #2 is laminated with RC-3 and panels are sealed together with Perastik Acrylic HBT (1mm) Glass Seal Tape.
B. **FLM4: Light filtering film shall be dye colored polyester film designed for the control of specific spectral light and transmission levels, heat treated with UV inhibitors.**

1. Light-filtering film shall have the following minimum properties.
   b. Visible Light Reflectance: 4.5 percent.
   c. Shading Coefficient: 0.70
   d. Emissivity: 0.88
   e. Ultraviolet Transmission (UV): Less than 1 percent.
   f. Combustion Rate: Negligible
   g. Melting Point: 240 to 265° C.
   h. Thickness: 2.2 mil
   i. Haze (Abrasion Differential): 1.94

2. Light filtering film shall be optically clear and free of waves, distortions, impurities, and adhesive lines.

3. Film may be a single layer or laminated. Lamination of film shall only occur at the factory of the light filtering film manufacturer.

4. The film shall include an abrasion resistant coating on the surface that does not receive the film adhesive. Abrasion resistance shall be per ASTM D1044.

5. The film shall be supplied with an optically clear weatherable pressure sensitive adhesive. The adhesive shall contain ultraviolet inhibitors to protect the film for its required life and limit ultraviolet transmission.

C. **Flame Spread and Smoke Density**

1. The light filtering film shall exhibit a flame spread index not exceeding 25 and a smoke density index not exceeding 100 when tested in accordance with ASTM E84.

### 2.6 GLAZING SEALANTS:

A. **Elastomeric Glazing Sealants:** Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant specified.

1. Single-Component Neutral-Curing Silicone Glazing Sealants Type S, Class 50:
   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. Tremco; Spectrem 1 (Basic).
   d. GE Silicones; SilPruf SCS2000.
   e. Pecora Corporation; 864.
   f. Pecora Corporation; 890.
   g. Sonneborn, Div. of ChemRex, Inc.; Omniseal.
   h. Tremco; Spectrem 3.

### 2.7 GLAZING TAPES:

A. **Back-Bedding Mastic Glazing Tapes:** Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended by tape and glass manufacturers and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

### 2.8 MISCELLANEOUS GLAZING MATERIALS:

A. **General:** Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine framing glazing, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face or edge clearances.
   4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION:

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL:

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 FILM APPLICATION:

A. Preparation:
   1. Glass surfaces to receive light filtering film shall be cleaned of paint, foreign compounds, smears, spatters, and other detrimental matter. After initial cleaning, the surface to receive the film shall be further cleaned in accordance with the film manufacturer's instructions

B. Installation:
   1. After surface preparation, apply light-filtering glazing film in accordance with the manufacturer's recommendations and instructions.
   2. Film shall be applied to the interior (room) side of glass, unless otherwise indicated. Install without bubbles, ripples, drips, dirt, cuts, tears, or gaps between film and frame.
   3. Do not apply film shall if there are visible dust particles in the air, if there is frost on the glazing, or if any room condition such as temperature and humidity do not meet the manufacturer's instructions. After film application, room conditions shall be maintained as required by the manufacturer's instructions to allow for proper curing of the adhesive.
   4. Splicing: Splices or seams in light-filtering film are not permitted.

C. Cleaning and Protection:
   1. Clean newly installed light-filtering film and window frames. Clean cleaning solutions, run-off cleaning water, and adhesive mounting solution from adjacent surfaces in accordance with manufacturer's recommendations.
   2. Where installed film could be damaged by subsequent construction work provide tape warning strips or barricades to prevent contact.
   3. Damaged glazing surface film applications shall be removed in accordance with manufacturer's instructions and replaced with new film.

D. Field Inspection:
   1. The applied light filtering film shall be clean and free of peeling, splitting, scratches, creases, wrinkles, discoloration, and foreign particles. The film application shall be free of bubbles after 30 days.
2. Light-filtering film shall not show signs of waviness and distortion at time work is accepted. This determination shall be made by the unaided eye (except for corrective prescriptive glasses), when the film is viewed from a distance of 10 feet from interior room side.

3. Unacceptable light filtering film applications shall be removed in accordance with manufacturer's instructions and new film applied.

3.5 TAPE GLAZING:

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.6 GASKET GLAZING (DRY):

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.7 SEALANT GLAZING (WET):

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.8 CLEANING AND PROTECTION:

A. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

B. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.
   3. Thin-set ceramic tile.

B. Removal of existing floor coverings.

C. Preparation of new concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs for moisture and alkalinity (pH).

1.2 RELATED REQUIREMENTS:

A. Section 01400 - Quality Requirements: Additional requirements relating to testing agencies and testing.

1.3 REFERENCES:


C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.


F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.5 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Visual Observation Report: For existing floor coverings to be removed.
C. 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.

D. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Include certification of accuracy by authorized official of testing agency.
   7. Submit report to Architect.
   8. Submit report not more than two business days after conclusion of testing.

E. Adhesive Bond and Compatibility Test Report.

F. Copy of RFCI (RWP).

1.6 QUALITY ASSURANCE:

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.8 FIELD CONDITIONS:

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.
PART 2 - PRODUCTS

2.1 MATERIALS:

A. Patching Compound: Floor covering manufacturer’s recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
   3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

PART 3 - EXECUTION

3.1 CONCRETE SLAB PREPARATION:

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Preliminary cleaning.
   2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Specified remediation, if required.
   6. Patching, smoothing, and leveling, as required.
   7. Consult the finish flooring manufacturer's instructions for acceptable substrate flatness tolerances.
   8. Other preparation specified.
   10. Protection.

C. Remediation:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
   2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
   3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.
3.2 REMOVAL OF EXISTING FLOOR COVERINGS:
A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.3 PRELIMINARY CLEANING:
A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
B. Do not use solvents or other chemicals for cleaning.

3.4 MOISTURE VAPOR EMISSION TESTING:
A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F1869 and as follows.
D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
F. Report: Report the information required by the test method.

3.5 INTERNAL RELATIVE HUMIDITY TESTING:
A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F2170 Procedure A and as follows.
D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
F. Report: Report the information required by the test method.
3.6 ALKALINITY TESTING:
A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.7 PREPARATION:
A. See individual floor covering section(s) for additional requirements.
B. Comply with recommendations of testing agency.
C. Comply with requirements and recommendations of floor covering manufacturer.
D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
E. Do not fill expansion joints, isolation joints, or other moving joints.

3.8 ADHESIVE BOND AND COMPATIBILITY TESTING:
A. Comply with requirements and recommendations of floor covering manufacturer.

3.9 APPLICATION OF REMEDIAL FLOOR COATING:
A. Comply with requirements and recommendations of coating manufacturer.

3.10 PROTECTION:
A. Cover prepared floors with building paper or other durable covering.

END OF SECTION
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SECTION 09111
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES:
A. Metal partition, ceiling, and soffit framing.
B. Drywall Suspension Systems
C. Framing accessories.

1.2 RELATED REQUIREMENTS:
A. Section 05400 - Cold-Formed Metal Framing, for exterior non-loading bearing structural metal stud framing, interior wall openings greater than 8 feet wide, and headers, interior soffits and ceilings where;
   1. Load is greater than 20 psf transverse
   2. Load is greater than 200 lbs axial.
B. Section 05500 - Metal Fabrications: Metal fabrications attached to stud framing.
C. Section 05500 - Metal Fabrications: Execution requirements for anchors for attaching work of this section.
D. Section 07213 – Building Insulation: Insulation.
E. Section 07620 - Sheet Metal Flashing and Trim: Head and sill flashings
F. Section 07840 - Firestopping: Sealing top-of-wall assemblies at fire rated walls.
G. Section 08305 - Access Doors and Panels.
H. Section 09260 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

1.3 REFERENCE STANDARDS:
A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.


I. ASTM E413 - Classification for Rating Sound Insulation; 2010.

J. ASTM F1267-12 Standard Specification for Metal, Expanded, Steel


L. Steel Stud Manufacturers Association (SSMA).

M. Steel Framing Industry Association (SFIA).

1.4 SUBMITTALS:

A. See Section 01330 - Submittal Requirements, for submittal procedures.

B. Shop Drawings:
   1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
   2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
   3. Provide shop drawings and calculations prepared by an engineer registered in the State of State as required in this Section including:
      a. Suspension systems.
      b. Ceiling framing and soffits.
      c. Engineering analysis depicting stress and deflection requirements for each framing application.
      d. Selection of framing components, accessories, fasteners, and welded connection requirements.

C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
   1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE:

A. Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years experience and approved by manufacturer.

B. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-structural steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by, and displaying a classification label from, an independent testing agency acceptable to authority having jurisdiction.
1. Construct fire-resistance-rated partitions in compliance with tested assembly requirements indicated on the Drawings.

2. Rated assemblies to be substantiated from applicable testing using the proposed products, by Contractor.

3. Both metal framing and wallboard manufacturers must submit written confirmation that they accept the other manufacturer’s product as a suitable component in the assembly. Acceptance is as follows:
   a. If installation of both products is proper, no adverse effect will result in the performance of one manufacturer’s product by the other’s products.
   b. Combining products can be substantiated by required assembly tests.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

D. Sound test reports must be from an independent laboratory accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP).

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Furnish products as Manufactured by a Manufacturing member of the Steel Stud Manufacturers Association (SSMA) www.ssma.com, or Steel Framing Industry Association (SFIA) and subject to compliance with Specification requirements.
   1. Metal Framing, Connectors, and Accessories:

B. Substitutions: See Section 01630 - Product Substitutions.

2.2 FRAMING MATERIALS:

A. Fire Rated Assemblies: Comply with applicable code and as indicated on drawings.

B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf. Framing shown as 18 gauge or heavier is specified under Section 05400 - Cold Formed Metal Framing.
   1. Studs: C shaped with flat or formed webs, punched, and size as indicated on the drawings with knurled faces.
   2. Curved Stud and Track Components: 2-1/2 inch, 3-5/8 inch and 6 inch hand shapeable, pivotal track components manufactured of structural Grade 22, hot-dipped galvanized steel with a protective coating equal to G-60, as manufactured by:
      a. Basis of Design: Flex-C Trac by Flex-Ability Concepts, Edmond, OK (405) 302-0611
      b. Custom curved stud and track components as manufactured by Radius Track Corporation, 6612 Lyndale Avenue South, Suite 2, Richfield, MN 55423 (888) 872-3487.
   5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
6. Steel Stud Framing Connectors:
   a. Products:
      1) Simpson Strong Tie, Bridging Connectors; DBC Bridging Connector: www.strongtie.com.
      2) Substitutions: See Section 01630 - Product Substitutions.

C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   1. Manufacturers - Shaft Wall Studs and Accessories:
      a. Same manufacturer as other framing materials.

D. Proprietary Framing System:
   1. Framing system for gypsum board panels consisting of cold-rolled steel members conforming to ASTM C635, with exposed surfaces finished in manufacturer’s standard enamel paint finish.
   3. Components: Main tees, furring cross channels, furring cross tees, and cross tees.
   4. Accessories:
      a. U-shaped channel molding.
      b. Galvanized carbon steel (12 ga.) hanger wire.
   5. Acceptable product: Equivalent to Drywall Suspension System by USG.

E. Ceiling Hangers and Tie Wire: Type and size as specified in ASTM C754 for spacing required.

F. Ceiling Isolation Hangers: Provide hangers and accessories as manufactured by Kinetics Noise Control, Inc., Dublin, Ohio.

G. Compression Struts: C- shape steel studs, in minimum thickness as required to adequately resist the vertical component induced by the bracing wires in suspended ceiling applications. Pre-manufactured struts, specifically designed for horizontal restraint of suspended ceiling systems, similar to USG’S Donn Compression Posts. Site fabricated posts of 1/2 inch and 3/4 inch EMT may be used if fabricated and installed in accordance with ICBO Evaluation Report 4071 and acceptable to the governing authority.

H. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
   4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.
   5. Deflection and Firestop Track:
      a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
      b. Acceptable Products:
         1) "Posi Clip" by Fire Trak Corporation.
         2) "The System" by Metal-Lite, Inc.

I. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs. Deflection track to have deep leg, minimum 2 inches.

J. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
K. Clips, Brackets: ASTM A653 Galvanized wire or sheet metal designed for attachment of framing, furring and bridging members.
   1. Deflection Clips: If acceptable to Building Official, VertiClip™ as manufactured by Signature Industries, LLC, P.O. Box 68005, Raleigh, NC 27613 (919) 844-0789 may be provided for attachment of framing to roof and floor construction at head and slip conditions. Provide sizes as required for stud depth(s). Clips shall be manufactured of steel conforming to ASTM A653 Prime Certified G60 galvanized material or better, 50 ksi yield strength and 65 ksi ultimate strength. Deflection clips to have positive attachment to structure and stud material while allowing for frictionless movement.
   2. Bridging Clips: If acceptable to Building Official, BridgeClip™ as manufactured by Signature Industries, LLC, P. O. Box 68005, Raleigh, NC 27613 (919) 844-0789 may be provided for attachment of bridging to studs.

L. Fasteners:
   1. ASTM C1002 self-piercing tapping screws.
   2. GA 203, self-drilling, self-tapping screws.

M. Sheet Metal Backing: Provide backing plate, stud or proprietary backing members of type and configuration indicated on Drawings, and as follows: .0625 inch
   1. 16 gauge minimum galvanized steel sheet.
   2. 16 gauge minimum c-shaped steel stud.
   3. "Notch-Tite" and "Flush Mount" as manufactured by Metal Lite, Inc., 3070 E. Miraloma Avenue, Anaheim, CA 92806 (800) 886-6824.

N. Anchorage Devices: Powder actuated, Drilled expansion bolts, or Screws with sleeves.

O. Acoustic Insulation: As specified in Section 07213.

P. Acoustic Sealant: As specified in Section 07900.

Q. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

2.4 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.
B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify existing conditions before starting work.
B. Verify that rough-in utilities are in proper location.

3.2 INSTALLATION OF STUD FRAMING:

A. Comply with requirements of ASTM C754.
B. Extend partition framing to structure where indicated and to ceiling in other locations as indicated on the drawings.
C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

E. Align and secure top and bottom runners at 24 inches on center and within 6 inches from the end.

F. At partitions indicated with an acoustic rating:
   1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
   2. Place two beads of acoustic sealant between runners and substrate, studs and adjacent construction.
   3. Place two beads of acoustic sealant between studs and adjacent vertical surfaces. At exterior wall conditions, install felt strips between the stud and wall.

G. At partitions indicated with a fire rating: Install framing and furring indicated for the required rating.

H. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

I. Install studs vertically at spacing indicated on drawings.

J. Align stud web openings horizontally.

K. Secure studs to bottom track using fastener method. Do not weld.

L. Stud splicing is permissible; splice studs with 8 inch nested lap, secure each stud flange with flush head screw.

M. Fabricate corners using a minimum of three studs.

N. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.

O. Brace stud framing system rigid.

P. Coordinate erection of studs with requirements of door frames and window frames; install supports and attachments.

Q. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

R. Blocking: Use steel channels secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and other wall mounted items.

S. Use sheet metal backing, 16 gauge minimum for reinforcement of all wall mounted items and items requiring backing per manufacturer's instructions.

3.3 CEILING AND SOFFIT FRAMING:

A. Comply with requirements of ASTM C754.
B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

C. Install furring independent of walls, columns, and above-ceiling work.

D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated.

E. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.

F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

I. Laterally brace suspension system.

J. Provide separate support members on each side of control or expansion joints. Do not bridge.

3.4 TOLERANCES:

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION
SECTION 09240
PORTLAND CEMENT (STUCCO) PLASTER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal furring and lathing.
B. Portland cement plaster (stucco) system.
C. Metal channel suspended ceiling/soffit framing.

1.2 SUBMITTALS

A. Shop Drawings: Include suspension systems, framing system, control joint locations and details.
B. Product Data: Provide manufacturer's information on plaster materials, characteristics and limitations of products specified.

1.3 QUALITY ASSURANCE

A. Apply cement plaster in accordance with ASTM C926 and PCA Plaster (Stucco) Manual.

1.4 QUALIFICATIONS

A. Applicator: Company specializing in cement plaster work with three (3) years documented experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to the requirements of IBC except where more restrictive requirements are specified in this section.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply plaster when substrate or ambient air temperature is less than 50 degrees F nor more than 80 degrees F.
B. Maintain minimum ambient temperature of 50 degrees F during and after installation of plaster.

PART 2 - PRODUCTS

2.1 PLASTER BASE COAT MATERIALS

A. Cement: ASTM C150, Normal - Type I Portland. ANSI/ASTM C91, integral color as shown on drawings.
B. Lime: ANSI/ASTM C206, Type S.
D. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.
E. Fiber Reinforcement: Fibermix Stealth by Fibermesh Co., or equal.

2.2 PLASTER FINISH COAT MATERIALS
A. Cement: As specified for plaster base coat, integral color as selected by Architect.
B. Lime: As specified for plaster base coat.
C. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.
D. Fiber Reinforcement: Fibermix Stealth by Fibermesh Co., or equal.

2.3 LATH AND ACCESSORIES
A. Metal Lath: 3.4 lb/sq yd expanded metal, galvanized finish with kraft paper back.
B. Corner Mesh: 26 gage galvanized steel with 2" expanded flanges.
C. Corner Beads: 26 gage galvanized steel.
D. Base Screeds: 26 gage square edged galvanized steel.
E. Casing Bead: 26 gage galvanized steel with expanded flanges.
F. Control and Expansion Joint Accessories: 26 gage accordion profile galvanized steel with 2 inch expanded flanges.
G. Anchorages: Nails, staples, or other approved metal supports, of type and size to suit application, galvanized to rigidly secure lath and associated metal accessories in place. Size and spacing shall conform to IBC requirements.

2.4 FRAMING AND FURRING MATERIALS
A. Resilient Channels: 25 gauge hat shaped formed steel.
B. Furring Channels: 20 gauge, 7/8" hat shaped formed steel.
C. Ceiling Channels: 16 gauge, 1-1/2" cold rolled galvanized steel.
D. Hanger Wire: 8 gauge galvanized steel.

2.5 CEMENT PLASTER MIXES
A. Mix and proportion cement plaster in accordance with manufacturer’s instructions.
B. Base Coat and Brown Coat: One part cement, minimum 3-1/2 and maximum 4 parts aggregate, and minimum 15 percent and maximum 25 percent hydrated lime.
C. Finish Coat: One part cement, minimum 3 and maximum 4 parts aggregate, and minimum 15 percent and maximum 25 percent lime.
D. Add fiber reinforcement in accordance with manufacturer's instructions.
E. Mix only as much plaster as can be used in one hour.
F. Mix materials dry, to uniform color and consistency, before adding water.
G. Do not retemper mixes after initial set has occurred.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that surfaces and site conditions are ready to receive work.

B. Grounds and Blocking: Verify items within walls for other Sections of work have been installed.

C. Mechanical and Electrical: Verify services within walls have been tested and approved.

3.2 PREPARATION

A. Protect surfaces near the work of this Section from damage or disfiguration.

3.3 CEILING/SOFFIT INSTALLATION

A. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.

B. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.

C. 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.

D. 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.

E. Space hanger wires as required by IBC for carrying channel spacing and within 6" of ends.

F. Install carrying channels at 36" O.C. and within 6" of walls. Provide 1" clearance between channels and abutting walls.

G. Lap channels 12" at splices.

H. Install furring channels at right angles to carrying channels at 16" O.C. and within 6" of walls and maintain 1" clearance to walls.

I. Secure channels and splices with 18 gauge tie wire.

J. Reinforce openings in ceiling which interrupt carrying or furring channels with lateral channel bracing.

K. Verify location and sizes of access doors.

3.4 INSTALLATION - LATHING MATERIALS


B. Attach lath to substrate below with mechanical anchors.

C. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement. Fasten at perimeter edges only.
D. Place beaded external angle with mesh at corners. Fasten at outer edges only.

E. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

F. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.

G. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

H. Install accessories to lines and levels as shown on drawings.

3.5 CONTROL AND EXPANSION JOINTS

A. Locate exterior control and expansion joints every 12 feet in each direction unless shown otherwise on drawings.

B. Maximum of 144 sq ft of area between expansion/control joints. Maximum of 100 sq. ft. at ceilings.

C. Establish control and expansion joints with specified joint device. Cut lath behind expansion joints but not control joints.

D. Coordinate joint placement with other related work.

3.6 PLASTERING

A. Apply plaster in accordance with manufacturer's instructions and patterns shown on drawings.

B. Masonry Substrate: Apply brown coat to a nominal thickness of 3/8 inch and a finish coat to a nominal thickness of 1/8 inch over masonry surfaces.

C. Framing Substrate: Apply scratch coat to a nominal thickness of 3/8 inch, brown coat to a nominal thickness of 3/8 inch, and a finish coat to a nominal thickness of 1/8 inch over metal lathed surfaces.

D. Scratch and brown coats will contain glass fibers at a rate of 1-1/2 pounds per sack of cement.

E. Moist cure scratch and brown coats two (2) days following application.

F. After curing, dampen brown coat prior to applying finish coat.

G. Apply finish coat and steel trowel to a consistent finish. Finish texture shall be approved by Architect.

H. Avoid excessive working of surface. Delay trowelling as long as possible to avoid drawing excess fines to surface.

I. Moist cure finish coat for minimum of forty-eight (48) hours.

3.7 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet.

END OF SECTION
SECTION 09260
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:
A. Gypsum board.
B. Taped and sanded joint treatment.

1.2 RELATED SECTIONS:
A. Section 07213 - Building Insulation: for Batt sound (acoustical) insulation.
B. Section 07900 - Joint Sealants.

1.3 REFERENCES:
E. ANSI/ASTM C645 - Nonstructural Steel Framing Members.
F. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2013
O. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.
P. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.
Q. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2012
T. ICBO (International Conference of Building Officials) Evaluation Report 4071

1.4 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data: Include manufacturer's literature on metal framing, ceiling suspension systems, gypsum board, joint tape and compound.
   1. Provide data on gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
C. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

1.5 QUALITY ASSURANCE:
A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than twenty-five (25) years of documented experience.
B. Installer Qualifications: Company specializing in performing, with minimum five (5) years of documented experience and approved by manufacturer.
C. Regulatory Requirements: Comply with the applicable codes relating to the fire rated assemblies as shown on the drawings.
D. Perform work in accordance with USG's Gypsum Construction Handbook.

1.6 DELIVERY, STORAGE AND HANDLING
A. Comply with GA-216 and Manufacturer's instructions.

1.7 REGULATORY REQUIREMENTS
A. Conform to applicable IBC for fire rated assemblies in conjunction with metal framing requirements of this section.

PART 2 - PRODUCTS
2.1 MANUFACTURERS - GYPSUM BOARD SYSTEM:
A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.
1. United States Gypsum Co.
2. Pablo.

C. Substitutions: See Section 01630 - Product Substitutions.

2.3 GYPSUM BOARD MATERIALS:

A. Gypsum Wallboard:
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Glass mat faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
   b. Mold resistant board is required at all locations.
4. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
5. Thickness:
   c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

B. Abuse Resistant Wallboard:
1. Application: As indicated on Drawings.
2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
6. Glass Mat-Faced Type: Gypsum wallboard as defined in ASTM C1658/C1658M.
7. Type: Fire resistance rated Type X, UL or WH listed.
8. Thickness: 5/8 inch.
10. Products:
    a. Georgia-Pacific Gypsum; DensArmor Plus Abuse-Resistant.

C. Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas including drinking fountains etc.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
   a. Standard Type: Thickness 1/4 or 5/8 inch.
   b. Fire Resistant Type: Type X core, thickness 5/8 inch.
D. \textbf{Backing Board For Non-Wet Areas}: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Type: Regular and Type X, in locations indicated.
   5. Type X Thickness: 5/8 inch.

E. \textbf{Ceiling Board}: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 5/8 inch.

\subsection*{2.4 ACCESSORIES:}

A. \textbf{Finishing Accessories}: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
   3. Corner Beads: GA216; Type CB; electro-galvanized steel.
   4. Edge Trim: GA216; Type L bead; electro-galvanized steel and Type LC rolled-formed zinc. Milcore No. 66 J-metal edge, or as approved by Architect, at unfinished gypsum board edges against other finish materials.
   6. Manufacturers - Finishing Accessories:
      a. Same manufacturer as framing materials.
      c. U.S. Gypsum.

B. \textbf{Screws}:
   1. ASTM C1002 for steel drill screws. Type G for fastening to gypsum board and Type S for fastening to light gauge steel framing.
   2. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

C. \textbf{Joint Materials}: ANSI/ASTM C475; reinforcing tape, joint compound, adhesive, water, and fasteners.
   2. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.

D. \textbf{Texture Material}: Spray-applied, compatible with joint system.
   1. As manufactured by USG, multi-purpose, pre-packaged, non-asbestos type.

E. \textbf{Fasteners}: ASTM C1002 Type S for 20 gage and lighter metal studs, complying with IBC requirements.
   1. Type G for fastening to gypsum board.
   2. Type S for fastening to light gauge steel framing.

F. \textbf{Drywall Primer}:
   1. Paint material specifically formulated to fill the pores and equalize the suction difference between gypsum board surface paper and the compound used on finished joints,
angles, fastener heads and accessories and over skim coatings.

2. Drywall primer which is applied to the finished surface of the work specified in this section shall be provided as specified under Section 09900 as applicable.

3. A good quality, white latex drywall primer formulated with high binder solids, applied undiluted, and shall be applied to gypsum board surfaces prior to the application of texture materials.

G. Accessories for Tile Backer Units:
   1. Fasteners: Stainless steel drill screws of size and type recommended by tile backer unit manufacturer for fastening tile backer units to metal studs as indicated.
   2. Joint Tape for Cementitious Backer Units: As recommended by cementitious backer unit manufacturer and complying with ANSI A118.9 and ANSI A108.11.

H. Wall Texture: As manufactured by USG, multi-purpose, pre-packaged, non-asbestos type.

I. Acoustic Insulation: As specified in Section 07212.

J. Acoustical Sealant: As specified in Section 07900.

K. Outlet Acoustical Box Pad: As specified in Section 07900.

L. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Verify that site conditions are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.2 CEILING INSTALLATION:

A. Install ceiling suspension system in accordance with recommended industry practices included in USG's Gypsum Construction Handbook, and ASTM C754.

B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.

C. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.

D. 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.

E. 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.

F. Space hanger wires as required by IBC for carrying channel spacing.

G. Install carrying channels at 48" O.C. and within 6" of walls. Provide 1" clearance between channels and abutting walls.

H. Lap channels 12" at splices.
I. Install furring channels at right angles to carrying channels at 16" O.C. and within 6" of walls and maintain 1" clearance to walls.

J. Secure channels and splices with 18 ga. tie wire.

K. Reinforce openings in ceiling which interrupt carrying or furring channels with lateral channel bracing.

L. Provide horizontal restraint consisting of:
   1. Four No. 12 gauge wires secured to main runners within 2 inches of cross runner intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling.
   2. Struts fastened to the main runner extending to and fastening to structure above. Place struts 12 feet on center in both directions with the first point within 6 feet from each wall.

3.3 ACOUSTICAL ACCESSORIES INSTALLATION:

A. Install acoustical sealant within partitions where indicated on drawings, and where walls all called out to have acoustical batt insulation. Install continuous beads of acoustical sealant to produce an airtight seal at intersections of partitions with floors, ceilings, walls, columns and all abutting construction so that the entire perimeter is sealed. At openings and cut outs, fill spaces between gypsum board and ducts, pipes and other penetrating items with acoustical sealant.

B. Electrical Boxes: Provide where indicated on drawings and at all wall types designated as acoustical partitions. Wrap completely in self-adhesive acoustical box pads. Leave no gaps.

3.4 GYPSUM BOARD INSTALLATION:

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Install gypsum board in accordance with manufacturer's instructions, recommended industry practices included in USG's Gypsum Construction Handbook and in accordance with requirements of assembly rating where rated construction is called for.
   1. Install moisture resistant gypsum board at all wall locations that receive ceramic tile.
   2. Install 5/8 inch thick, type X gypsum board at all other wall locations.

C. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

D. Double-Layer Non-Rated: Use gypsum board for first layer, placed perpendicular to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer. Secure the second layer to the first layer with adhesive and support to hold in place.

E. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

F. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

G. Use screws when fastening gypsum board to metal furring or framing. Screw fasteners to conform to IBC requirements for type of screw and screw spacing.
H. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum ceiling board with sealant.

I. Place control joints consistent with lines of building spaces, and at a maximum of 30 feet center to center. Also place control joints where base wall construction contains building control or expansion joints.

J. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated. Miter corners of a trim and reveal mouldings.

K. Gypsum board shall be held 1/8 inch maximum off of the finish floor and set in a bead of silicone sealant. Any gaps between the finish floor and bottom of gypsum board that exceeds 1/8 inch in fire rated walls shall be filled with a fire sealant at the expense of the Contractor.

3.5 JOINT TREATMENT:

A. Glass Mat Faced Abuse Resistant Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
   1. Seal at all screw heads with water resistant sealant.
   2. Seal all joints prior to taping with water resistant sealant.

B. Provide tape and joint compound finish at all exposed joints edges and corners to produce smooth surface ready to receive finishes. Finish shall be Gypsum Associations Level 4 Finish system as follows:
   C. Apply tape pressed into joint compound or by mechanical tool designed for this process. Apply joint compound to all fastener heads and accessories.
   D. Apply second coat of joint compound to extend beyond joint center approximately 3-1/2 inches. Apply to a smooth even plane. After drying or setting sand or smooth as needed to eliminate high spots or excessive compound. Apply joint compound to all fastener heads and accessories.
   E. Apply third coat of joint compound except at concealed locations not subject to view. Third coat shall be applied to feather edges approximately 6 inches from center of joint. After drying, lightly sand to leave a smooth even surface. Apply joint compound to all fastener heads and accessories.
   F. Provide spray-applied texture to all gypsum board exposed to view.
      1. Spray apply finish texture coating (light orange peel as approved by Architect) in accordance with manufacturer’s instructions.
      2. Remove any texture droppings or overspray from door frames, windows and other adjoining work.

3.6 FINISHES:

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
      a. Joints and interior angles shall have tape embedded in joint compound and 2 separate coats of joint compound applied over flat joints and one separate coat applied over interior angles.
      b. Fastener heads and accessories shall be covered with 3 separate coats of joint compound.
      c. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface to fill imperfections in the
joint work, smooth the paper texture and provide a uniform surface for decorating. Excess compound shall be immediately sheared off, leaving a film of skim coating compound completely covering the paper.

d. The surface shall be smooth and free of tool marks and ridges.

e. Surface to be coated with Drywall Primer as specified herein prior to application of texture.

f. Untextured surfaces to be coated with Drywall Primer prior to application of final finishes as specified in Section 09900 as applicable.

2. Level 4: (Typical finish for all interior locations, unless otherwise indicated) (Appearance areas to receive flat paints, light texture, or where backed wallcoverings are to be applied. This level of finish is not to be used where gloss, semi-gloss and enamel paints are to be applied.):

a. Joints and interior angles shall have tape embedded in joint compound and 2 separate coats of joint compound applied over flat joints and one separate coat of joint compound applied over interior angles.

b. Fastener heads and accessories shall be covered with 3 separate coats of joint compound.

c. Joint compound shall be smooth and free of tool marks and ridges.

d. Surface to be coated with Drywall Primer as specified herein prior to application of texture.

e. Untextured surfaces to be coated with Drywall Primer prior to application of final finishes as specified in Section 09900 as applicable.

3. Level 3: (Utility and Mechanical Spaces) (Appearance areas to receive heavy or medium texture (spray or hand applied) finishes before final painting, or where heavy grade wallcoverings are to be applied as final decoration. This level of finish is not to be used where smooth painted surface or light to medium wallcoverings are to be applied.):

a. Joints and interior angles shall have tape embedded in joint compound and one additional coat of joint compound applied over joints and interior angles.

b. Fastener heads and accessories shall be covered with 2 separate coats of joint compound.

c. Joint compound shall be smooth and free of tool marks and ridges.

d. Surface to be coated with Drywall Primer as specified herein prior to application of texture.

e. Untextured surfaces to be coated with Drywall Primer prior to application of final finishes as specified in Section 09900 as applicable.

4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish. (Areas to receive applied wall panels, wood paneling, applied products, etc.):

a. Joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating joint compound over joints and interior angles.

b. Fastener heads and accessories shall be covered with a coat of joint compound.

c. Surface shall be free of excess joint compound.

d. Tool marks and ridges are acceptable.

e. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.

5. Level 1: Fire rated wall areas above finished ceilings, in attics, in areas where the assembly will be concealed or in building service corridors and other areas not normally open to public view whether or not accessible in the completed construction.

a. Joints and interior angles shall have tape embedded in joint compound.

b. Surface shall be free of excess joint compound.

c. Tool marks and ridges are acceptable.

6. Level 0: Temporary partitions and surfaces indicated to be finished in later stage of project. No taping, finishing, or accessories required.
B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile and fixed cabinetry.
   3. Taping, filling and sanding is not required at base layer of double layer applications.

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.7 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.8 TOLERANCES:

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION
SECTION 09510
SUSPENDED ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Suspended metal grid ceiling system.
B. Acoustical panels.
C. Above ceiling acoustical insulation.

1.2 REFERENCES:

A. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
B. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

1.3 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittal requirements.
B. Product Data: Submit manufacturer's data on metal grid system components, suspension trim system and acoustic units.
C. Samples: Submit five (5) samples illustrating material and finish of acoustic units of each panel and tile type and five (5) samples, 6 inches long, of suspension system main runner, cross runner and edge trim.
D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention and anchorage requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacture of ceiling suspension system and ceiling tile with ten (10) years minimum experience.
B. Installer: Company with five (5) years minimum experience.
1.5 REGULATORY REQUIREMENTS:
   A. Conform to IBC, ASCE and CISCA requirements for Seismic Design Category listed in Design Data on Drawings.
      1. For Seismic Design Category C: Comply with CISCA Recommendations for Seismic Zones 0-2.
      2. Alternative design and installation requirements included in ICC Evaluation Report ESR-1222 may be utilized provided all the requirements of the Evaluation Report are met.

1.6 ENVIRONMENTAL REQUIREMENTS
   A. Maintain uniform temperature of minimum 60 degrees F and humidity of 20 to 40 percent prior to, during, and after installation.

1.7 EXTRA MATERIAL
   A. Provide two (2) cartons of each type of ceiling panel and tile installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - SUSPENSION SYSTEM
   A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
      1. Armstrong World Industries, Inc
   B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.
      1. USG Interiors.
      2. Chicago Metallic Corp.
   C. Substitutions: See Section 01630 – Product Substitutions for substitution procedures.

2.2 ACOUSTICAL PANELS:
   A. Acoustical Panels Type AP:
      2. Composition: Mineral Fiber.
      4. Size: 24 in. x 24 in.
      5. Edge Profile: Square Lay-In 15/16 or 1-1/2IN for interface with 15/16" Co-Extruded Clean Room grid.
      6. Noise Reduction Coefficient(NRC):
      7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 40.
      8. Sabin: N/A.
      11. Light Reflectance White Panel: ASTM E 1477; 0.80.
13. Recycle Content: Post-Consumer - 1% Pre-Consumer Waste - 40%.

2.3 SUSPENSION SYSTEM:

A. Rating: For Seismic Design Category C, provide intermediate-duty grid in accordance with ASTM C635.

B. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A653. Main beams and cross tees are double-web steel construction with exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.
   1. Structural Classification: ASTM C635 Intermediate Duty
   2. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
   3. Acceptable Product: 15/16” Co-Extruded Clean Room as manufactured by Armstrong World Industries.

C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

D. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

E. Edge Moldings and Trim:
   1. EA7812 - Molding Clean Room 12ft,15/16 IN Angle
   2. Exposed Trim and Accessories: Formed steel finished to match grid.

F. Accessories: Provide edge trim, hanger wires, support channels and other accessories as required for a complete system in size and configuration shown on drawings and in accordance with IBC, ASCE and CISCA requirements.
   1. UHDC - Universal Hold Down Clip.

G. Finish: Factory finished, white.

2.4 SOUND INSULATION:

A. Basis of Design: Knauf Equipment Liner M or approved equal.

B. Acoustical Batt Insulation: Glass Mineral Wool insulation complying with ASTM C 665; non-combustible when tested in accordance with ASTM E 136.
   1. Size Over Ceilings: Minimum thickness of 2 inches at 1.5 PCF.
   2. Facing: None, Unfaced; ASTM C 665, Type I, Class A.
   3. Surface Burning Characteristics: Maximum flame spread of 25, maximum smoke developed of 50, when tested in accordance with ASTM E 84.
   4. Noise Reduction Coefficient: 0.90, when tested on 2 inch (50 mm) samples in accordance with ASTM C 423.
   5. Facing: Kraft paper faced; ASTM C 665, Type II, Class C; extra wide stapling flanges.
   6. Free of Formaldehyde: Insulation is manufactured with bio-based binder and no formaldehyde
   7. VOC Emission: Low VOC emission certified by UL Environment GREENGUARD Gold(formerly Children and Schools)
PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that existing conditions are ready to receive work.
B. Verify that layout of hangers will not interfere with other work.
C. Coordinate installation in areas containing major ductwork.
D. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION:

A. Do not install acoustical ceilings until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Schedule installation of acoustic units after interior wet work is dry.

3.3 INSTALLATION:

A. Install system in accordance with ASTM C636, IBC, ASCE and CISCA requirements for designated Seismic Design Category and as supplemented in this Section. Alternative installation designs included in ICC Evaluation Reports ESR-1222 or ESR-1308 are acceptable if all the requirements of the reports are met.
B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum and in accordance with the details on the drawings.
C. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
D. Hang system independent of walls, columns, ducts, pipes and conduit.
   1. For Seismic Design Category C: Sprinkler heads and other penetration shall have a minimum of 1/4 inch clearance on all sides.
E. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.
   1. For Seismic Design Category C: All perimeter closure angles or channels shall provide a support ledge of 7/8 inch minimum and end of grid members shall have minimum 3/8 inch clearance from wall or edge.
F. Where ducts or other equipment prevent the regular spacing of hangers, trapeze above or below interfering members.
G. Locate system on room axis according to reflected plan.
H. Do not eccentrically load system, or produce rotation of runners.
I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner, or support components independently.
J. Form expansion joints as required. Form to accommodate plus or minus one inch movement. Maintain visual closure.
K. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

L. Install acoustic units level, in uniform plane, and free from twist, warp and dents.

3.4 TOLERANCES:

A. Variation from Flat and Level Surface: 1/8 inch in 10 ft.

3.5 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer’s instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

C. Before disposing of ceilings, contact the Armstrong Recycling Center at 877-276-7876, select option #1 then #8 to review with a consultant the condition and location of building where the ceilings will be removed. The consultant will verify the condition of the material and that it meets the Armstrong requirements for recycling. The Armstrong consultant with provide assistance to facilitate the recycle of the ceiling.

END OF SECTION
SECTION 09670
RESINOUS FLOORING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:
A. This Section includes one resinous flooring system, one with (MMA) methyl methacrylate body.
   1. Application Method: Squeegee, screed, and broadcast.
B. Coved seamless wall base.

1.2 RELATED REQUIREMENTS
A. Section 03300 - Cast-in-Place Concrete.
B. Section 07900 - Joint Sealants.
C. 09056 - Common Work Results for Flooring Preparation.

1.3 REFERENCE STANDARDS
F. ASTM D635-14 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
I. ASTM D2047-11 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine
J. ASTM D2170 / D2170M-10 - Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens)


Q. ASTM E1745-11 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

R. ASTM F1869-16 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.


1.4 QUALITY ASSURANCE

A. No request for substitution shall be considered that would change the generic type of floor system specified (i.e. MMA, methyl methacrylate based quartz broadcast). Equivalent materials of other manufactures may be substituted only on approval of Architect or Engineer. Request for substitution will only be considered only if submitted 10 days prior to bid date. Request will be subject to specification requirements described in this section.

B. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

2. Contractor shall have completed at least 10 projects of similar size and complexity.

C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

D. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.

1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
E. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Apply full-thickness mockups on 48-inch (1200-mm) square floor area selected by Architect.
      a. Include 48-inch (1200-mm) length of integral cove base.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Pre-installation Conference:
   1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
   2. Attendance:
      a. General Contractor
      b. Architect/Owner's Representative.
      c. Manufacturer/Installer's Representative.

1.5 SUBMITTALS:
   A. See Section 01330 - Submittal Procedures, for submittal requirements.
   B. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
   C. Delete paragraph below if not required.
   D. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
   E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
   F. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 PRODUCT STORAGE AND ENVIRONMENTAL CONDITIONS
   A. Material temperatures shall be a minimum of 55°F before use.
   B. Work on seamless flooring shall not commence until the building can be maintained at a minimum temperature of 55 °F for 48 hours before, during and 48 hours after application. Areas shall also be broom clean and reasonably dust free and shall have adequately controlled ventilation with bright, uniform lighting.

1.7 PROJECT CONDITIONS
   A. Before commencing work, ensure environmental and site conditions are suitable for application and curing.
   B. Surfaces shall be acceptable in accordance with flooring manufacturer's recommendations.
   C. Notify Architect and Contractor in writing of unsuitable surfaces and conditions. Commencement of work shall imply acceptance of surfaces and working conditions.
      1. Recommended Moisture Vapor Transmission Considerations:
         a. Placement of on-grade slabs over a Class A vapor retarder as defined by ASTM E1745.
         b. A water cement ratio of 0.45 and 0.5.
         d. A slump in the range of 3 to 4 inches which can be increased by the use of...
1.8  PROTECTION

A. Protect adjacent surfaces from damage resulting from work of this trade. If necessary, mask and/or cover adjacent surfaces, fixtures, cabinet work, equipment, etc. by suitable means.

1.9  WARRANTY

A. See Section 01780 - Warranties and Bonds, for additional warranty requirements.

B. Applicator shall notify manufacturer of project requirements before bidding. Manufacturer shall provide single source warranty for entire installation including labor for two years. Warranty shall include removal and replacement if proven defective. Defective items are but not limited to debonding, discoloration, excessive wear and staining by bodily fluids.

PART 2 - PRODUCTS

2.1  MANUFACTURER:

A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.

1. Manufacturer: Stonhard, 1000 East Park Avenue, Maple Shade, NJ 08052, 800.257.7953

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.

C. Substitutions: See Section 01630 - Product Substitutions.

2.2  MATERIALS:

A. A nominal 3/32 to 1/8 in./2 mm to 3 mm flooring system that combines a decorative appearance with excellent chemical, stain and wear resistance. This methyl methacrylate resin based system provides quick turn-around times and a moderate degree of slip resistance.

1. Product: Stontec Xpress, comprised of:
   a. Primer: A two-component, low viscosity, methyl methacrylate resin primer.
   b. Undercoat: A three-component, medium viscosity, methyl methacrylate resin.
   c. Flakes: Brightly colored, quartz broadcast aggregate.
   d. Sealer: A two-component, UV resistant methyl methacrylate sealer.

2. Color: Refer to Drawings and Finish Schedules.

B. Provide 6" high turned up coved base with 3/4" radius cove as indicated on drawings, for an integral seal at the joint between the floor and the wall.

C. Binder and all successive mortar coats shall be 100% solids Cementitious Urethane resin.
PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer’s written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   1. Mechanically prepare substrates as follows:
      a. Mechanically prepare with the use of Diamond grinding equipment to provide surface sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring. Or,
      b. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
      c. Comply with ASTM C 811 requirements, unless manufacturer’s written instructions are more stringent.
   2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer’s written recommendations.
   3. Verify that concrete substrates are dry.
      a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 80 percent.
      b. For applying impermeable resinous flooring systems, 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in 24 hours is generally considered a safe moisture-vapor-emission rate. Consult manufacturers for appropriate rates for permeable systems that will allow moisture vapor to continue through them once cured.
      c. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. of slab in 24 hours.
      d. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
   4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer’s written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer’s written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer’s written recommendations. Allowances should be included for Stonflex MP7 joint fill material.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer’s written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
   a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates

C. Broadcast: Immediately broadcast quartz aggregate into the primer using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners. Refer to detail drawings.

E. Undercoat: Remove any surface irregularities by lightly abrading and vacuuming the floor surface. Mix and apply undercoat with strict adherence to manufacturer's installation procedures and coverage rates.

F. Broadcast: Immediately broadcast quartz silica aggregate into the undercoat using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

G. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 TERMINATIONS

A. Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.

B. Penetration Treatment: Lap and seal flooring system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.

D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.4 JOINTS AND CRACKS

A. Treat control joints to bridge potential cracks and to maintain monolithic protection.

B. Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

C. Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.5 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any numbers of times during resinous flooring
application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.

3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.6 CLEANING, PROTECTING, AND CURING

A. Cure resinous flooring materials in compliance with manufacturer’s directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.

B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer’s recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.

C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacture.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Surface preparation and application of paints and coatings

B. Surface finish schedule.

C. Field application of paints, stains, varnishes, and other coatings.

D. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Exposed surfaces of steel lintels and ledge angles.
   3. Prime surfaces to receive wall coverings.
   4. Mechanical and Electrical:
      a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
      c. On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished.
      d. Paint interior surfaces of air ducts and convectors and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      e. Paint dampers exposed behind louvers, grilles, and convectors and baseboard cabinets to match face panels.

E. Do Not Paint or Finish the Following Items:
   1. Items fully factory-finished unless specifically so 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 so indicated.
   7. Concealed pipes, ducts, and conduits.

1.2 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Provide data on all finishing products and special coatings, including VOC content and;
      a. Product characteristics.
      b. Surface preparation instructions and recommendations.
      c. Primer requirements and finish specification.
      d. Storage and handling requirements and recommendations.
      e. Application methods.
f. Cleanup Information.

2. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
3. MPI product number (e.g. MPI #47).
4. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
5. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.

C. Samples: Submit six (6) paper "draw down" samples of each color selected, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified, or six (6) manufacturer's paint charts with each selected color clearly identified.
1. Where sheen is specified, submit samples in only that sheen.
2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.

D. Samples shall be submitted at least 30 days prior to the start of painting work. Label and identify each sample as to location and application. Upon submittal of color samples, minor variations or changes in color selection may be requested by the Architect and new samples ordered, until final color approval.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and coated surfaces, and color samples of each color and finish used.
1. Coating Maintenance Manual: upon conclusion of the project, the Contractor or paint manufacture/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01600 - Product Requirements, for additional provisions.
2. Provide all broken lot containers of paint to Owner.
3. Provide 5 gallons of each trim color in fresh, unopened containers.
4. Provide 5 gallons of each wall color in fresh, unopened containers.
5. Provide paint color chart reflecting brands, all colors and mixing formulas
6. Extra Paint and Coatings: 1 gallon of each color; store where directed.
7. Label each container with color, type, texture, room locations, and shelf life in addition to the manufacturer's label.

1.3 QUALITY ASSURANCE:

A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with ten (10) years experience.

B. Applicator: Company specializing in commercial painting and finishing with five (5) years documented experience.

C. Standards: Preparation, application and workmanship shall be in accordance with manufacturer's recommendations and applicable provisions of the following:
1. Painting and Decorating Contractors of America (PDCA) "Painting Specification Manual" and "Standards".
   c. PDCA P3-13: Designation of Paint Color.
   d. PDCA P4-13: Responsibility for Inspection and Acceptance of Surfaces Prior to Painting and Decorating.
   e. PDCA P5-13: Benchmark Sample Procedures for Paint and Other Decorative Coating Systems.


1.4 REGULATORY REQUIREMENTS:
   A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

1.5 DELIVERY, STORAGE AND HANDLING:
   A. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
   B. Container labeling to include manufacturer's name, type of paint, brand name, drying time, cleanup, color designation, and instructions for mixing and reducing.
   C. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
   D. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.6 ENVIRONMENTAL REQUIREMENTS:
   A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
   B. Do not apply exterior coatings in damp weather or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
   C. Minimum application temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
   D. Provide lighting level of 80 ft. candles measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – PAINT:
   A. Furnish products of one of the following manufacturers, except as otherwise approved by Architect, subject to compliance with specification requirements.
   B. Substitutions: See Section 01630 - Product Substitutions.
2.2 MATERIALS:

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.

C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

D. All paint products shall contain no mercury compounds.

E. Provide materials in accordance with the Schedule of Paint Products at the end of this Section as applicable to project. Contractor shall provide either waterborne or solventborne products at contractor's option and as follows:
   1. Waterborne:
      a. Provide where low odor and fast dry are desired.
      b. Non-blocking materials shall be used for doors, door jambs, railings and other locations subject to handling, or where surfaces will come into contact with other painted surfaces or belongings.
   2. Solventborne:
      a. Provide where harder finish is required (such as "wet" areas) and odor will not create problems with occupants.
      b. These products shall not be used where color retention is a concern. Verify with Architect.
   3. Materials used shall comply with applicable Federal and local air pollution regulations, lead content laws, and current VOC requirements. If products listed in Schedule of Paint Products located at the end of this Section are not in compliance with regulations, laws, or requirements, Contractor shall notify Architect and shall provide information regarding substitute products.

F. Basic painting materials such as linseed oil, shellac, turpentine, thinners, driers, and other similar products, shall be of highest quality, made by reputable, recognized manufacturers, and have identifying labels on containers. Paint materials shall be factory fresh.

G. Alternate materials submitted for prior approval shall have qualities and materials equal to the other listed manufacturer's scheduled, top of the line, first quality products. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Verify that substrate conditions 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.

3.2 PREPARATION:

A. General:
   1. Surfaces requiring painting or finishing shall be thoroughly dry and cured, free of dirt, dust, rust, stains, scale, mildew, wax, grease, oil, deteriorated substrates, bond-breakers, efflorescence and other foreign matter detrimental to the coating's adhesion and performance. Repair voids, cracks, nicks and other surface defects with appropriate
patching material. Finish flush with surrounding surfaces and match adjacent finish texture.

2. Spot prime marred or damaged shop coats on metal surfaces with appropriate metal primer.

3. Determine moisture content of plaster, stucco, cementitious materials, wood, and other moisture-holding materials by use of a reliable electronic moisture meter.

4. Determine alkalinity of plaster, stucco and other cementitious materials by performing appropriate tests.

5. Do not paint surfaces where moisture content or alkalinity exceeds that which is allowed by paint manufacturer.

3.3 PREPARATION - PREVIOUSLY PAINTED SURFACES:

A. Comply with all requirements for preparation for new construction as listed below and the following requirements for existing, previously painted surfaces:

B. Surfaces which cannot be prepared or painted as specified shall be immediately brought to the attention of the Architect in writing.

C. Clean all surfaces free of all dirt, dust, loose and unsound paint coatings and other foreign matter by hydrowash method with additional scraping and sanding as required. Provide a clean, sound surface for the new paint coatings.

D. Repair cracks and voids in plaster surfaces.

E. Prior to surface preparation and painting operations, mask, remove or otherwise adequately protect all hardware, accessories, machined surfaces, plates, fire sprinkler heads, lighting fixtures and similar items in contact with painted surfaces but not scheduled to receive paint.

F. Spot prime exposed nails and other metals which are to be painted with emulsion paints, using a primer recommended by the manufacturer of the coating system.

G. Clean all ferrous metal surfaces until they are completely free from dirt, oil and grease. After cleaning, apply one coat of the specified primer the same day to all ferrous metal surfaces scheduled to be painted.

H. Clean all galvanized metal surfaces thoroughly with solvent until they are completely free from dirt, oil and grease. Then treat thoroughly with phosphoric acid etch. Remove all excess etching solution and allow to dry completely before application of paint.

I. Remove efflorescence by wire brushing, power brushing or washing. Thoroughly rinse surfaces wire brushed. After removal of efflorescence, wash the surface with a commercially available cleaner acceptable to the manufacturer of the substrate.

J. Remove existing wallcovering and wash the surface to remove paste residue. Seal surface before making any surface repairs.

K. Dull and roughen glossy surfaces to obtain proper adhesion by either sanding, washing with a tri-sodium phosphate solution, or treating with a liquid deglossing compound.

L. Overlap and feather edge spot-primed areas.

3.4 PREPARATION - NEW CONSTRUCTION:

A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
B. Correct minor defects and clean surfaces which affect work of this Section.

C. Shellac and seal marks which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

F. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.

G. Galvanized Surfaces: Remove surface contamination and oils, wash with solvent, apply coat of etching primer.

H. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

J. Steel and Iron:
   1. Remove grease, oil, mill scale, rust and rust scale and touch-up chipped or abraded places on items that have been shop coated. Remove and reprime incompatible or damaged shop applied primers. Comply with the Steel Structures Painting Council's (SSPC) recommendations for cleaning of uncoated steel and iron surfaces.
   2. When area will be exposed to view, sandpaper the entire primed area smooth, feather the edge of surrounding undamaged prime coat and spot prime in a manner to eliminate evidence of repair.
   3. Where steel or iron at existing Work have a heavy coating of scale, remove by sand blasting, sanding, descaling, grinding or wire brushing, as necessary, to produce a satisfactory surface for painting.

K. Galvanized Metal and Aluminum:
   1. Thoroughly clean by wiping surfaces with a non-hydrocarbon solvent that will not leave an oily residue. Apply surface conditioner or vinyl-wash pretreatment as required for proper adhesion if required by paint manufacturer. Prime galvanized metal with galvanized iron primer as recommended by paint manufacturer. A test sample of the complete painting system should be applied and checked for adhesion before final painting begins.
   2. Clean visible portions of throats of galvanized steel ductwork with solvent; wipe dry with clean rags and paint flat black.

L. Concrete:
   1. The method of surface preparation shall be at Contractor's discretion, provided the results are satisfactory to the Architect, and the method is in compliance with applicable codes and requirements.
   2. Clean and prepare surfaces of tilt-up precast concrete wall panels to be painted by power washing surface to remove all efflorescence, chalk, dust, dirt, grease, oils and release agents.
   3. Repair surfaces to be painted prior to application of prime and finish coat(s). Apply a tinted primer to the substrate to help identify surface imperfections. After the primer has thoroughly dried, patch, fill and repair surface imperfections to match and flush-out with...
adjacent finish texture and profile.

4. Before first paint coat is applied, spot prime nails and other exposed metal occurring in the surfaces with a rust inhibitive primer as recommended by paint manufacturer.

M. Plaster and Gypsum Board Surfaces:
1. Fill cracks, holes or imperfections with compatible patching material and smooth off to match adjoining surfaces. Before painting, surfaces shall be first tested for dryness with a moisture testing device.
2. Apply no paint or sealer on gypsum board or plaster when the moisture content exceeds 8 percent. Test sufficient areas in each space and as often as necessary to determine if the surface has the proper moisture content for painting. If the moisture content is between 8 percent and 12 percent, prime with alkali resistant primer.
3. If 8 percent or less, prime with specified primer. Remove the dry salt deposits from plaster surfaces by brushing with a stiff brush before painting.

N. Acoustical Surfaces (Lay-in acoustical ceiling panels, acoustical wall panels, etc.):
1. Thoroughly vacuum clean surfaces to remove dust and debris from acoustical surface pores. Use a soft brush attachment that will not damage or loosen acoustical surface.
2. Seal surface stains with a suitable stain blocking sealer that will not fill pores of acoustical surface.
3. Apply no paint or sealer on gypsum board or plaster when the moisture content exceeds 8 percent. Test sufficient areas in each space and as often as necessary to determine if the surface has the proper moisture content for painting. If the moisture content is between 8 percent and 12 percent, prime with alkali resistant primer.

O. Clean surfaces thoroughly and correct defects prior to coating application.

P. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

Q. Remove or repair existing coatings that exhibit surface defects.

R. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

S. Seal surfaces that might cause bleed through or staining of topcoat.

T. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

U. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

V. Gypsum Board Surfaces to be painted: Fill minor defects with filler compound. Spot prime defects after repair.

W. Plaster Surfaces to be painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

X. Asphalt, Creosote, or Bituminous Surfaces to be painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.

Y. Insulated Coverings to be painted: Remove dirt, grease, and oil from canvas and cotton.
Z. Concrete Floors and Traffic Surfaces to be painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

AA. Aluminum Surfaces to be painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

BB. Galvanized Surfaces to be painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

CC. Corroded Steel and Iron Surfaces to be painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).

DD. Uncorroded Uncoated Steel and Iron Surfaces to be painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

EE. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

FF. Metal Doors to be painted: Prime metal door top and bottom edge surfaces.

3.5 APPLICATION:

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Allow applied coat to dry before next coat is applied.

H. The number of coats scheduled is the minimum number of coats required. Additional coat(s) shall be applied, at no additional cost to the Owner, to completely hide base material, provide uniform color and to produce satisfactory finish results.

I. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

J. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

K. Apply coatings without thinning except as specifically required by label directions, or required by these specifications. In such cases, thinning shall be the minimum reduction permitted.
L. Priming will not be required on items delivered with prime or shop coats, unless otherwise specified. Touch up prime coats applied by others as required to ensure an even primed surface before applying finish coat.

M. Block Fillers: Provide level of block fill as scheduled to conform with the following:
   1. Level 1 - Regular Fill: Minimum block fill, reduces irregularity in masonry profile. One coat, spray applied.
   2. Level 2 - Medium Full Fill: Masonry profile slightly reduced. One coat, spray applied and back-rolled.
   3. Level 3 - Full Fill: Minimum block fill required for semi-gloss and gloss finishes. Use where conformance with health regulations is required. Number of coats as required to conceal most of masonry texture, spray applied and back-rolled.
   4. Level 4 - High Density Fill: Minimum of three coats. 1st coat massaged and forced into masonry texture to assure uniform high density. 2nd coat, with build sufficient to fully conceal masonry texture and joints. Additional coats as required to level. Spray apply coats, back-roll and squeegee final coat. Add sand to final coat to achieve light sand texture where indicated.

N. Paint exposed surfaces of every member; paint items inaccessible after installation before installation, if required to be painted. Edges, tops and bottoms of wood doors shall be sealed and finished with the same finish as the door faces, to meet door manufacturer's warranty requirements. Verify edge color with Architect as different colors may be selected for each face.

O. Paint items fitted with finish hardware after hardware has been temporarily removed.

P. Heating and other equipment on or adjacent to walls or surfaces scheduled for painting, shall be disconnected, using workmen skilled in appropriate trades and moved temporarily to permit painting of surface. Following completion of painting, replace and reconnect items.

Q. Brush, wipe or roll stain in 2 coat application. Avoid lap marks by maintaining "wet-edge" continually being merged with existing liquid coverage and stop only at natural edges, turns and breaking places.

R. Do not paint over Underwriters' Laboratory labels, fusible links, exposed sprinkler heads and other similar items.

S. Paint surface of walls which will be concealed by cabinets and other wall mounted items.

T. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

U. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

V. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

W. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

3.6 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT:

A. Paint shop primed equipment and shop prefinished items.

B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
C. Spray paint prime coated (not pre-finished) grilles and registers with enamel or lacquer to match walls and ceilings. Paint materials shall not sag, run or bind movable parts of grilles, registers, louvers, baffles and other similar items.
   1. Throats of ducts shall be given one coat of flat black paint, wherever visibility of the interior of the duct is allowed through registers or other similar items. At fiber lined duct, use black latex paint.
   2. Paint interior surfaces of air ducts, and convectors and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
   3. Examine the Mechanical and Electrical Drawings and Specifications to determine the amount of exposed work to be painted.

D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports except where items are prefinished.

E. Replace identification markings on mechanical or electrical equipment when painted accidentally.

F. Paint exposed unfinished fixtures, metal ducts, switch boxes, control panels, devices, starters, junction boxes, vents, drains, and other similar items, as directed by Architect.

G. Color code equipment, piping, conduit, and exposed ductwork in accordance with requirements indicated. Color band and identify with flow arrows, names and numbering.

H. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

I. Exterior and interior exposed water, gas, waste piping, sprinkler piping, conduit, lighting and electrical panels, telephone terminal boxes, galvanized ducts and insulated ducts, shall be painted in areas other than mechanical rooms, unless otherwise scheduled.

3.7 FIELD QUALITY CONTROL:

A. See Section 01400 - Quality Requirements, for general requirements for field inspection.

B. Painted exterior and interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the Architect:
   1. Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
   2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
   3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
   4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
   5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

C. Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
   1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39”).
   2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39”).
   3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

D. Painted surfaces rejected by the Architect shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

E. Paint System Manufacturer’s Technical Representative
   1. The paint system manufacturer’s technical representative shall be present at the jobsite for the pre-painting conference and for the first day of paint application, and shall be available for consultation for the full project duration.

F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.8 CLEANING:
   A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
   B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
   C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.9 PROTECTION:
   A. Protect elements surrounding the work of this Section from damage or disfiguration.
   B. Repair damage to other surfaces caused by work of this Section.
   C. Furnish drop cloths, shields, and protective methods to prevent disfiguring other surfaces.
   D. Remove empty paint containers from site.

3.10 SCHEDULE - INTERIOR SURFACES:
   A. Interior Gypsum Board:
      1. First Coat: Acry-prime Acrylic
      2. Second Coat: Acrylic Semi-Gloss Enamel
      3. Third Coat: Acrylic Semi-Gloss Enamel
   B. Interior Gypsum Board Ceilings and Soffits (None wet locations):
      1. First Coat: Acry-prime Acrylic
      2. Second Coat: Acrylic Flat Enamel
      3. Third Coat: Acrylic Flat Enamel
   C. Interior Ferrous Metals:
      1. First Coat: Epoxy based metal Primer
      2. Second Coat: Water Based Semi-Glass Enamel
      3. Third Coat: Water Based Semi-Glass Enamel
   D. Interior Galvanized Metals:
      1. First Coat: Epoxy based metal primer
      2. Second Coat: Water Based Semi-Glass Enamel
      3. Third Coat: Water Based Semi-Gloss Enamel
E. Interior Hollow Metal (Ferrous and Galvanized)
   1. First Coat: Factory primed finish or epoxy based metal primer
   2. Second Coat: Water Based Semi-Glass Enamel
   3. Third Coat: Water Based Semi-Gloss Enamel

END OF SECTION
SECTION 09960
GRAFFITI RESISTANT COATINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. High Performance Graffiti Resistant Coatings consisting of:
   1. Clear Epoxy Primer Coating
   2. Clear Polyurethane Top Coating.

1.2 RELATED SECTIONS

A. Section 04 20 00 - Unit Masonry.

1.3 SUBMITTALS:

A. See Section 01330 - Submittal Procedures, for submittal requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Surface preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Successful experience in application of similar finish systems.
   2. Employ persons trained for application of finish systems.

B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Area shall be the Unit Masonry mock-up panel specified in Section 04 20 00 unless another location is designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.


D. Pre-installation Meeting:
   1. Convene a meeting before the start of the application of. Require attendance of parties directly affecting work of this section, including Contractor, Architect, and applicator.
   2. Review surface preparation, application, protection, and coordination with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handling: Protect materials during handling and application to prevent damage or contamination.
1.6 PROJECT CONDITIONS
A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.
B. Do not install products under environmental conditions outside manufacturer's recommended limits.
C. Exterior Surfaces: Do not apply materials in wet weather.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
A. Acceptable Manufacturer: EPMAR Corporation, Kemiko Industrial Coatings.
B. Substitutions: See Section 01630 - Product Substitutions.

2.2 EPOXY PRIMER COATINGS
A. Water Extended Epoxy Coating equal to Kemiko SS1600. (Basis of Design)
B. Type: Two component, water extended epoxy coating, low-VOC, water clean-up, low odor, and designed to be used as a thin film resilient primer/finish.
C. Volume Solids: Clear - 45 percent, Pigmented - 45 percent.
D. VOC: Clear - Max VOC 250 g/l, Pigmented - Max VOC 100 g/l.
E. Flash Point >200 degree F (93 degree C).
F. Sheen: Gloss.
G. Mix Ratio: Clear - 1:3 (A:B) by volume 1:4 (A:B) by volume (most).
H. Film Thickness: 3 to 5 mils DFT.
I. Thinning: 10 to 15 percent by volume with clean water only.
J. Primers: Self priming.
K. Topcoat: Kemiko SS2700 Series Polyurethane.

2.3 POLYURETHANE COATINGS
A. Waterborne Aliphatic Polyurethane Coating equal to Kemiko SS2700. (Basis of Design)
B. Type: Two component, waterborne, high-solids, aliphatic polyurethane coating.
C. Flash Point: >200 degree F (93 degree C) (nonflammable).
D. Sheen: High gloss.
E. Dry Film Thickness: 2.5 to 3.5 mils.

G. Volume Solids: Clear - 75 percent. Pigmented - 77 percent.


I. Film Thickness: 4 to 5 mils (wet to achieve 3 to 4 mils dry film thickness. Do not exceed 6 mils wet film thickness - air entrapment and foaming may occur.

J. Thinning: Add 10 percent to 15 percent water for brush and roller, 20 percent for spray.

K. Primer: Kemiko SS1600.

L. Color: Clear.

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 EPOXY PRIMER COATING APPLICATION

A. Concrete and Masonry Surface Preparation:
   1. All visible oil, grease, sludge, and any other contaminants shall be removed prior to any abrasive surface preparation and water washing.
   2. Surface shall be cured, dry and free from alkali stain and laitance.
   3. Prepare surfaces in accordance with SSPC-SP7 Brush-Off Blast Cleaning, Blas-Trac or other approved mechanical method to achieve a 60-80 grit profile for long term adhesion and non-slip surface on floors.
   4. Repair all cracks, holes, and grout joints in an approved manner.

B. Environment: Apply between 60 degrees F and 100 degrees F and 5 degrees above dew point.

C. Wall and Surface Wetting: In advance of the coating application to help allow for absorption of the applied material, spray water onto the surface to slightly dampen using a Hudson type sprayer.

D. Apply epoxy coating in accordance with manufacturer's instructions at locations indicated on the drawings.

E. Mix components and thin in accordance with manufacturer's instructions. Do not use mixed materials beyond pot life limits. Keep material containers closed when not in use to avoid contamination.

F. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.

G. Uniformly apply epoxy coating at spreading rate required to achieve specified dry film thickness.

H. Apply epoxy coating to be free of film characteristics and defects that would adversely affect performance or appearance.
3.3 POLYURETHANE TOP COATING APPLICATION

A. Apply polyurethane coating in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Mix components and thin in accordance with manufacturer's instructions. Do not use mixed materials beyond pot life limits. Keep material containers closed when not in use to avoid contamination.

C. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.

D. Environment: Apply between 60 degrees F and 100 degrees F and 5 degrees above dew point.

E. Apply primer in accordance with manufacturer's instructions.

F. Uniformly apply polyurethane coating at spreading rate required to achieve specified dry film thickness.

G. Apply polyurethane coating to be free of film characteristics and defects that would adversely affect performance or appearance.

3.4 PROTECTION

A. Protect finishes from damage during construction.

B. Protect concrete surfaces from foot traffic for a minimum of 24 hours. Avoid washing concrete surfaces for a minimum of 48 hours.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION
SECTION 10140
SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES:
   A. Room and door signs
   B. Interior directional and informational signs
   C. Building identification signs
   D. Fire Extinguisher Signage
   E. Cast Plaques
   F. Lettering

1.2 RELATED REQUIREMENTS:
   A. Section 15190 – Mechanical Identification.
   B. Section 16075 – Identification for Electrical Systems.

1.3 REFERENCE STANDARDS:
   D. ATBCB ADAAG – Americans with Disabilities Act Accessibility Guidelines; 2004

1.4 MINIMUM SIGN REQUIREMENTS:

   A. Permanent Rooms and Spaces:
      1. Tactile and Braille Characters, raised minimum 0.793 mm (1/32 in). Characters shall be accompanied by Grade 2 Braille.
      2. Type Styles: Characters shall be uppercase, Helvetica Medium, Helvetica Medium Condensed and Helvetica Regular.
      3. Character Height: Minimum 16 mm (5/8 in) high, Maximum 50 mm (2 in).
      4. Symbols (Pictograms): Equivalent written description shall be placed directly below symbol, outside of symbol's background field. Border dimensions of symbol background shall be minimum 150 mm (6 in) high.
      5. Finish and Contrast: Characters and background shall be eggshell, matte or other non-glare finish with adequate contrast with background.
      6. Mounting Location and Height: As shown in drawings, mounted on wall adjacent to the latch side of the door and to avoid door swing and protruding objects.

   B. Overhead Signs:
      1. Type Styles: As shown. Characters shall have a width-to-height ratio between 3:5 and
1:1. Characters shall have a stroke width-to–height ratio of between 1:5 and 1:10.
2. Character Height: minimum 75 mm (3 in) high for overhead signs. As shown, for directional signs.
3. Finish and Contrast: Same as for signs of permanent rooms and spaces.
4. Mounting Location and Height: As shown in Drawings.

1.5 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data: Manufacturer’s printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts and colors.
   1. When room number to appear on signs differ from those on the drawings, include the drawing room number on schedule.
   2. When content of signs is indicated to be determined later, request such information from Owner through Architect; upon request, submit preliminary schedule.
   3. Submit for approval by Owner through Architect prior to fabrication.
D. Samples: Submit one sample of each room sign type, of size similar to that required for project, illustrating sign style, font and method of attachment; include sign insert features.
E. Selection Samples: Submit two sets of color selection chips.
F. Manufacturer’s Installation Instructions: Include installation templates and attachment devices.

1.6 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten (10) years of documented experience.
B. Any (substitution) material submitted as equal to the specified material must be accompanied by a notarized report signed and sealed by a professional engineer licensed in the state in which the installation is to take place. This report shall show that the submitted equal meets the criteria in this specification. Substitution requests submitted without notarized report will be rejected for non-conformance.
C. Signage System Manufacturer will issue a 7 year Limited Warranty on all products.

1.7 DELIVERY, STORAGE AND HANDLING:

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store tape adhesive at normal room temperature.

1.8 FIELD CONDITIONS:

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.
PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Signs:

B. Substitutions: See Section 01630 - Product Substitutions.

2.2 GENERAL

A. Signs of type, size and design shown on the drawings and as specified.

B. Signs complete with lettering, framing and related components for a complete installation.

C. Provide graphics items as completed units produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.

D. Do not scale drawings for dimensions. Contractor to verify and be responsible for all dimensions and conditions shown by these drawings. Resident Engineer to be notified of any discrepancy in drawing, in field directions or conditions, and/or of any changes required for all such construction details.

E. The Sign Contractor, by commencing work of this section, assumes overall responsibility, as part of his warranty of work, to assure that assemblies, components and parts shown or required within the work of the section, comply with the Contract Documents. The Contractor shall further warrant: That all components, specified or required to satisfactorily complete the installation are compatible with each other and with conditions of installations.

2.3 SIGN TYPES:

A. Flat Signs: Signage media without frame.
   1. Edges: Square.
   2. Corners: Square.
   3. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
   5. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.

2.4 SIGNAGE APPLICATIONS:

A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: 1 inch.
   4. Sign Height: 2 inches, unless otherwise indicated.
   5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
   6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
   7. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
   8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

C. Interior Directional and Informational Signs
   1. Type: Architectural standard to match room and door signs.
   2. Size: As indicated in drawings.
   3. Text: Wording of signs is scheduled on the Drawings. 4.
   4. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.

D. Exterior Room and Directional Signage:
   1. Type: Aluminum to meet code
   2. Size: As indicated in drawings.
   3. Text: Wording of signs is scheduled on the Drawings.

E. Fire Extinguisher Cabinets: Cabinets and enclosed compartments used to house portable fire extinguishers shall be clearly marked with the words FIRE EXTINGUISHER in letters at least 2 inches (51 mm) high.
   1. Identify extinguishers and cabinets with the words “FIRE EXTINGUISHER” in red letter decals applied to wall surface

2.5 DIMENSIONAL LETTERS (BUILDING IDENTIFICATION):

A. Metal Letters:
   1. Metal: Aluminum casting.
   2. Finish: Brushed, satin.

B. Plastic Letters:
   1. Material: Injection molded plastic.
   2. Color: As selected.

C. Building Identification and Monument Signs:
   1. Monument Insignia Sign: Furnished by Owner and installed by contractor.

2.6 ACCESSORIES:

A. Concealed Screws: Stainless Steel, galvanized steel, chrome plated or other non-corroding metal.

B. Construction Adhesive: GE Silicone or other commercial grade adhesive as required.
C. Tape Adhesive: Double-sided tape, permanent adhesive.

D. Room Sign Backer Plate: Same as room sign construction; located at glass sidelights location; or as required.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION:

A. Install in accordance with manufacturer’s instructions.

B. Install neatly, with horizontal edges level.

C. Install interior signs with both construction adhesive and tape adhesive.

D. Install room and door signs, scheduled at exterior locations, with stainless steel pan head screws per approved shop drawings.

E. Locate signs where indicated:
   1. Room Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
   2. If no location is indicated, obtain Owner’s instructions.

F. Protect from damage until Substantial Completion; repair or replace damaged items.

3.3 SCHEDULE:

A. Refer to Drawings.

END OF SECTION
SECTION 10260
WALL AND CORNER PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES:
A. Crash Rails.
B. Wall mounted corner guards.

1.2 RELATED SECTIONS:
A. Section 09111 - Non-Structural Metal Framing: for sheet metal backing.

1.3 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data: Provide specifications for each system component and installation accessory required, including installation methods for each type of substrate.
C. Shop Drawings: Show locations, extent and installation details of all products.
D. Samples: Submit four (4) samples of each product specified for verification of color, texture, pattern and thickness:
   E. Sample of each product specified.
   F. Maintenance Data: Submit for wall protection system components for inclusion in the operating and maintenance manuals.

1.4 QUALITY ASSURANCE:
A. Installer qualifications: Engage an installer who has no less than five (5) years experience in installation of systems similar in complexity to those required for this project.
B. Manufacturer’s qualifications: Not less than ten (10) years experience in the production of specified products and a record of successful in-service performance.
C. Fire Performance Characteristics: Provide wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class 1 characteristics listed below:
   1. Flame spread: 25 or less
   2. Smoke developed: 450 or less
D. Impact Strength: Provide assembled wall protection units that have been tested in accordance with the applicable provisions of ASTM F476.
E. Chemical and stain resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.
F. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.
1.5 DELIVERY, STORAGE AND HANDLING:
   A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.
   B. Store materials in original, undamaged packaging in a clean, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 40ºF (4ºC) and a maximum of 100ºF (38ºC) should be maintained.
   C. Materials must be stored flat.

1.6 PROJECT CONDITIONS:
   A. Materials must be acclimated in an environment of 65-75ºF (18-24ºC) for at least 24 hours prior to beginning the installation.
   B. Installation areas must be enclosed and weatherproofed before installation commences.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
   B. Inpro Corporation, PO Box 406 Muskego, WI 53150 USA; Telephone: 800.222.5556, Fax: 888.715.8407, www.inprocorp.com
   C. Substitutions: See Section 01630 - Product Substitutions.

2.2 MATERIAL:
   A. Stainless steel: To be type 304 alloy with #4 satin finish.
   B. Retainers: manufacturer's standard.
   C. Fasteners: All fasteners to be non-corrosive and compatible with aluminum retainers. All necessary fasteners to be supplied by the manufacturer.
   D. Color-matched sealant: Manufacturer's recommended sealant.
   E. Colors and textures as indicated on finish schedule.

2.3 CORNER GUARDS:
   A. Provide stainless steel corner guards where indicated on drawings. Surface mounted guards to be 16 gauge stainless steel.
      1. Model CO-8, 90° stainless steel corner guard with 3-½" (88.9mm) standard legs.
      2. Adhesive mounted and stainless steel screws.
      3. Partial height.
      4. Provide C/S Group Model SCO-8 at end-of-wall conditions.
2.4 CRASH RAILS:

A. Heavy duty crash rails shall be manufactured from 4" (101.6mm) wide x 1/4" (6.35mm) thick aluminum alloy 6061-T6 extrusion. Lengths to be supplied prefabricated with corners and end returns formed. End returns and corners shall not be separate pieces. All units pre-drilled. Mounting hardware shall be supplied by the manufacturer.
   1. Model ECR-32A Heavy duty aluminum crash rail 4" h (101.6mm) x ¼" (6.4mm) thick with continuous 2" (50.8mm) radiused ends standard, 135° corners available. Outside rail surface shall be no more than 3-¼" (82.6mm) from wall mounting surface. Aluminum tube bracket standard. Optional Z-bracket, H-bracket, heavy-duty H-bracket and adjustable bracket available.

B. Finishes:
   1. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applications and designations of finishes.
   2. Aluminum mill finish: AA-MIO

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
   1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.

B. Protection: Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.3 INSTALLATION:

A. Coordinate installation of corner guards, crash rail with adjacent work.

B. Do not install system items until after painting is complete.

C. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation to allow for proper adhesive set up.

D. Relative humidity shall not exceed 80%.

E. Do not expose wall covering to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination.

F. Install system items where indicated on drawings and schedules and in accordance with manufacturer's instructions.

G. Install wall protection in strict accordance with the manufacturer's recommendations using approved adhesive.

H. Provide corner guards 6 inches above finish floor and terminate 6 inches below finish ceiling.
I. Secure retainer with fasteners as recommended by the manufacturer, appropriate for the substrate.

J. Protect completed work from damage by other trades.

3.4 CLEANING:

A. General: Immediately upon completion of installation, clean material in accordance with manufacturer’s recommended cleaning method.

B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.5 PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION
SECTION 10523
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:
   A. Fire extinguishers.
   B. Cabinets.

1.2 RELATED SECTIONS:
   A. Section 09260 - Gypsum Board Assemblies.
   B. Section 09900 – Painting and Coatings.

1.3 REFERENCES:
   C. UL 299 - Dry Chemical Fire Extinguishers.
   E. Comply with ANSI/UL92 and 711.

1.4 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets and accessories and floor plan showing location of each type of cabinet or mounting.
   C. Product Data: Provide extinguisher operational features, color and finish, anchorage details and capacities.
   D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

1.5 OPERATION AND MAINTENANCE DATA:
   A. Submit under provisions of Section 01700.
   B. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.
1.6 REGULATORY REQUIREMENTS:
   A. Conform to ANSI/NFPA 10 for requirements for extinguishers.

1.7 ENVIRONMENTAL REQUIREMENTS:
   A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
   A. J.L. Industries.
   B. Larsen's Manufacturing Company.
   C. Potter-Roemer.
   D. Substitutions: See Section 01630 - Product Substitutions.

2.2 EXTINGUISHERS
   A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
      1. Provide extinguishers labeled by UL for the purpose specified and indicated.
   B. Water type, UL 626, stainless steel tank, pressurized, Class 2A, 2.5 gallon capacity,
   C. Dry Chemical Type: UL 299, Steel tank, with pressure gage; with pressure gage, DOT approved, with epoxy finish.
      2. Class: A: B: C.
      3. Capacity and UL Rating:
         a. 10 pound, 4A-80B:C
         b. 10 pound, 4A-80B:C
      5. Temperature range: Minus 40 degrees F to 128 degrees F.
      6. Type Discharge: Hose
      7. Metal valves and siphon tube.
      8. Replaceable molded valve stem seal.

2.3 CABINETS:
   A. Metal: Steel with polyester coating, white with decals to match existing cabinets in adjacent locations.
   B. Cabinet: Standard roll-radius semi-recess with 2 inch projection. Similar to Potter-Roemer’s “Alta” series.
   C. Configuration: Semi-recessed type with trim, sized to accommodate designated extinguishers. Provide rated cabinets for installation in rated wall assemblies. Cabinet shall be rated in accordance with ASTM E814. All cabinets shall include fire extinguisher brackets.
   D. Door: Full glass with handle and lock, match style of existing cabinets in adjacent locations. Provide piano hinge.
E. Door Glazing: manufacturer’s standard clear glass.
F. Cabinet Mounting Hardware: Appropriate to cabinet.

2.4 ACCESSORIES:

A. Extinguisher Brackets: Steel.
B. Mounting hardware: As recommended by manufacturer for substrate.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION:

A. Install in accordance with manufacturer's instructions.
B. Install at appropriate height so that extinguisher handle is a maximum of 54 inches above finished floor for compliance with ADA.
C. Install cabinets plumb and level in wall openings.
D. Secure rigidly in place.
E. Place extinguishers in cabinets on wall brackets.

3.3 SERVICE:

A. Service, charge and tag each fire extinguisher within two weeks of substantial completion.

END OF SECTION
SECTION 10800
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:
   A. Toilet and washroom accessories.
   B. Attachment hardware.

1.2 RELATED SECTIONS:
   A. Section 09260 - Gypsum Board Systems.
   B. Section 09300 - Ceramic Tile.
   C. Section 10175 – Solid Surface Toilet Partitions.

1.3 REFERENCES:
   C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
   D. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

1.4 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. Shop Drawings: Indicate on elevations of individual room's location, mounting heights and required clearances. Provide mounting details including requirements for backing and special anchorage.
   C. Product Data: Provide manufacturer's data on accessories describing size, finish, details of function, attachment methods.

1.5 EXTRA MATERIAL:
   A. Provide two (2) keys for each accessory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. As noted on schedule.
B. Other acceptable manufacturers are:
   1. Bradley Corp.
   2. Gamco Equipment

C. Substitutions: Under provisions of Section 01630.

2.2 MATERIALS:


B. Stainless Steel Sheet: ASTM A167, Type 304.

C. Tubing: ASTM A269, stainless steel.

D. Adhesive: Two component epoxy type, waterproof.

E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamperproof.

F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

G. Mounting Plates: As recommended by manufacturer.

H. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

2.3 FABRICATION:

A. Weld and grind smooth joints of fabricated components.

B. Form exposed surfaces from single sheet of stock, free of joints.

C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

D. Back paint components where contact is made with building finishes to prevent electrolysis.

E. Shop assemble components and package complete with anchors and fittings.

F. Provide steel anchor plates, adapters, and anchor components for installation.

G. Hot dip galvanize exposed and painted ferrous metal and fastening devices.

2.4 KEYING:

A. Provide 5 keys for each accessory to Owner; master key lockable accessories

2.5 FINISH:

A. Stainless Steel: No. 4 satin luster finish unless otherwise noted or scheduled.
PART 3 - EXECUTION

3.1 EXAMINATION:

A. Coordinate the work of this Section with the placement of internal wall reinforcement to receive anchor attachments where required by manufacturer.

B. Verify that site conditions are ready to receive work, including mounting plates, and dimensions are as indicated on drawings.

C. Beginning of installation means acceptance of existing substrate.

3.2 PREPARATION:

A. Deliver inserts, rough-in frames and mounting plates to site at appropriate time for building-in. Provide templates and rough-in measurements as required.

B. Verify exact location of accessories for installation.

3.3 INSTALLATION:

A. Install fixtures, accessories and items in accordance with manufacturers’ instructions.

B. Mounting heights shall be as required to comply with ADA requirements and ANSI A117.1 unless noted otherwise on drawings and schedules.

C. Install plumb and level, securely and rigidly anchored to substrate.

D. Clean all surfaces.

END OF SECTION
SECTION 11235
VIVARIUM CASEWORK & FURNISHINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. All casework, working surfaces and other items specified herein shown on the drawings shall be furnished, installed and shall be demonstrated to properly perform in accordance with the function specified herein. Provide all necessary fillers, scribes and miscellaneous accessories and hardware to provide a complete installation.

1.2 SECTION INCLUDES
A. Stainless steel casework, work surfaces, and sinks
B. Fume Hoods
C. Safety Shower/Eyewash units
D. Unistrut frames
E. Gas Manifold
F. Cylinder Restraint
G. Mop Rack.

1.3 RELATED SECTIONS
A. Division 9: Backing in Walls and Base Molding
B. Division 15: Plumbing. Related items specified by Div. 15 are mop sinks in vestibule corridor; Hose bibs and reels in Behavior Rooms; Hose bib at east end of building; Gas piping from gas cylinders in Store Room to fume hood in Procedure Room and Surgery Room.
C. Division 15: Mechanical
D. Division 16: Electrical. Related items specified by Div. 16 are surgery light in Surgery Room; wall recess mount electrical and data boxes and cover plates.

1.4 DELIVERY, STORAGE AND HANDLING
A. Schedule delivery of casework and equipment so that spaces are sufficiently complete to allow for installation immediately following delivery.
B. Protect finished surfaces from soiling or damage during handling and installation. Cover working surfaces with cardboard. Mark in large lettering "NO STANDING".

1.5 PROJECT CONDITIONS
A. Do not deliver or install equipment until the following conditions have been met:
B. Windows and doors are installed and the building is secure and weather tight.
C. Ceiling, overhead ductwork, and lighting are installed.

D. All painting is completed and floor finish is installed.

1.6 SUBMITTALS

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: Submit manufacturer's data for each item of vivarium furnishings and equipment. Include component dimensions, configurations, construction details, joint details and attachments. Indicate location, size and service requirement for each utility connection. See Specification Division 1 for additional general requirements.

C. Shop Drawings: Provide 1/2" = 1'0" scale elevations of each individual and battery of casework units showing cross sections, rough-in and anchor placements, tolerances and clearances. Indicate relationship of units to fume hoods, other vivarium equipment, surrounding walls, ceilings, windows, doors and other building components. Provide 1/4" = 1'0" rough-in plan drawings for coordination with trades. Rough-in shall show free area.

D. Top Material Samples: Submit 3" x 3" product sample of each type of bench top.

E. Hardware Samples: Provide samples of door and drawer pulls, locks and hinges.

F. Finish Samples: Submit 3" x 5" samples of each color of finish from manufacturer's standard color offering for casework and accessories for selection by the Owner's Representative.

G. Submit detailed seismic anchorage and attachment drawings and calculations complying with all applicable building code requirements and regulations for seismic restraint.

1.7 QUALITY ASSURANCE

A. Single Source Responsibility: All furnishings and equipment included in this section and shall be supplied by a single laboratory subcontractor. Proposals from brokers or multiple suppliers will not be accepted.

B. The supplier for work in this section shall use manufacturers with production facilities including all tools, equipment and special machinery necessary for specializing in the fabrication and installation of the type of equipment specified, with skilled personnel, factory trained workmen and an experienced engineering department. Each shall have the demonstrated knowledge, ability and the proven capability to complete an installation of this size and type within the required time limits: Ten years or more experience in manufacture of laboratory casework and equipment of type specified; ten installations of equal or larger size and requirements within the last five years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (listed in alphabetical order)

A. Jamestown
   Represented by Dow Diversified.
   Contact: Sue Clineff.
   Phone: 949.648.0992
   Email: suec@dowdiversified.com
B. Kewaunee Scientific
Represented by ISEC.
Contact: Bob Bell.
Phone: 480.240.7718.
Email: rbbell@isecinc.com

C. Mott Scientific
Represented by Saxton Bradley Inc.
Contact: Josh Rees.
Phone: 714.937.3096.
Email: josh.rees@saxtonbradley.com

2.2 DESIGN REQUIREMENT
A. Casework material: Epoxy powder coat metal (at fume hood) and 304 stainless steel. No wood products or wood materials of any kind shall be used in any of the casework construction, fabrication, and installation.
B. Door and drawer design: Flush overlay, square edge.
C. Modular, self-supporting units capable of interchangeable use.
D. Flush interiors: Set cupboard bottom flush with front-end facers. Surface mounted bottoms and offsets caused by front face frames which interfere with ease of cleaning are not acceptable.
E. Casework Color: Painted metal casework shall be from manufacturer’s standard line of colors. Contractor shall verify color with Owner’s Representative prior to ordering casework.

2.3 MATERIALS AND FINISHES
A. Painted metal: Epoxy powder coat on all visible or exposed surfaces. Painted metal casework shall be installed in all labs except where noted below for stainless steel.
B. Stainless steel: 304 grade, welded and ground smooth with #4 satin finish. Exposed or overlapping seams are not acceptable. Stainless steel casework, scullery sinks, tops, shall be installed in the following labs: Procedure Room; Prep Rooms; Surgery Room.
C. Glass: Tempered Safety Glass - 3mm (nominal 1/8") on framed glass doors on wall and upper cases and 6mm (nominal 7/32") on tall cases. Glass to be without imperfections or marred surfaces.

2.4 BASE CABINETS
A. Material: 304 stainless steel.
B. Base unit shelves are to be adjustable on 32mm centers.
C. Security Panels: Security panels shall be provided between lockable drawers.
D. Adjustable shelf: Base cabinets with doors shall have one (1) full-depth adjustable shelf.
E. Base cabinets at fume hoods: All fume hood base cabinets shall have matching epoxy powder coat painted metal exterior similar to other lab casework.
F. Sink base cabinets: Sink base cabinets shall be open to floor inside cabinet, with finished floor material and floor base inside cabinet. Toe kick shall be open, without panel. All sink base cabinets shall be 316L stainless steel, welded, ground smooth, seamless, with satin #4 finish.
G. Cabinet depth: base cabinets shall be minimum of 22” in depth, front to back.

H. Wall backing provided per Div. 9.

2.5 WALL/UPPER CABINETS

A. Material: 304 stainless steel.

B. Doorframes shall be 3” wide with tempered glass inset.

C. Adjustable shelves: Wall cabinets shall have two (2) rows of full-depth, adjustable shelves.

D. Task light valance: Provide 2” task light valance at bottom of all wall cabinets. Bottom of task light valance shall be 60” above finish floor.

E. Cabinet depth: wall cabinets shall be 15” in depth, front to back.

F. Wall backing provided per Div. 9.

2.6 TALL CABINETS

A. Material: 304 stainless steel.

B. Upper cabinet doorframes shall be 3” wide with tempered glass inset.

C. Lower cabinet doorframes shall be solid stainless steel.

D. Adjustable shelves: Upper cabinets shall have two (2) rows of full-depth, adjustable shelves. Lower cabinets shall have four (4) rows of full-depth adjustable shelves.

E. Cabinet depth: Tall cabinets shall be 15” in depth, front to back.

F. Wall backing provided per Div. 9.

2.7 WALL SHELVES AT EQUIPMENT SPACE

A. Location: Procedure Room.

B. Wall frame: Stainless Steel Unistrut P1000 welded frame with 2 vertical members from top of floor base to 96” above floor with horizontal P1000 at top of frame. Vertical members shall be spaced at 24” apart, centerline.

C. Shelf brackets: Stainless Steel Unistrut P2233A with stainless steel end cap.

D. Shelf: 1” x 35” x 24” black phenolic resin with screw attachment to shelf bracket.

E. Seismic rail: stainless steel post and rail with 2.5” post at each corner and mid-span front and back- total of 6 posts per shelf. Horizontal stainless steel quarter inch diameter rail at four sides, top of rail to be 2” above top of horizontal shelf surface.

2.8 WALL SHELVES AT SINK

A. Location: Procedure Room.
B. Wall frame: Stainless steel Unistrut P3300 welded frame with 2 vertical members from top of sink backsplash to 96” above floor with horizontal P3300 at top of frame. Vertical members shall be spaced at 24” apart, centerline.

C. Shelf brackets: Stainless steel Unistrut P2232A with stainless steel end cap.

D. Shelf: 1” x 35” x 15” black phenolic resin with screw attachment to shelf bracket.

E. Drying Rack: 36” x 36” black phenolic resin with polypropylene pegs mounted to vertical unistrut frame at wall.

2.9 HARDWARE

A. Drawer and hinged door pulls shall be 8” stainless steel wire pulls, mounted horizontally and centered left to right on drawer/door cabinet. Vertically mounted pulls are not acceptable.

B. Hinges: Aximat 300 Single Pivot Institutional Hinge with integrated catch.

C. Catch: No catches are required. Aximat Hinge has integrated catch.

D. Drawer suspension: Mechanical slides shall be full extension with overtravel, 150 lb. dynamic, zinc plated Accuride or equal. For drawers less than 6” high and less than 30” width shall have 100 lb. capacity slides.

E. Shelf supports: Seismic twin pin heavy duty clear plastic with 500 lb. rating. Provide Haafele catalog number 282.47.402.

F. Cabinet Key Locks: Olympus Small DCR Cam Lock. Master Key System: Each room or lab shall be lockable with one key. Provide master key for all labs. Contractor shall verify with Owner’s Representative which casework, if any, is to be lockable.

2.10 WORK SURFACES

A. Stainless Steel Work Surface: 304 stainless steel work surfaces with integral sinks shall be provided at all work surfaces. Benchtop depth shall be 30” front to back.

B. Stainless Steel Counter Backsplash: Integral stainless steel backsplash shall be installed at all stainless steel work surfaces and at stainless steel sink locations. Height of backsplash at benchtop shall be 6”. Height of backsplash at sinks shall be 12”. Backsplash shall be seamless with adjacent work surface.

2.11 SINKS

A. Material: 316L stainless steel, welded and ground smooth with satin #4 finish, integral to adjacent stainless steel benchtop and backsplash.

B. Sink Schedule:
   1. SK1 (Wall Sink)
      a. Location: Holding Room ABSL2
      b. Quantity: 1.
      c. Type: wall mount with integral 12” stainless steel backsplash.
      d. Overall sink dimensions: 24” long x 18” wide x 10” deep.
      e. Faucet: Watersaver #CT414-9VB-BH- Hot/Cold faucet Colortech series; Satin chrome finish; Vacuum breaker; 9” swing gooseneck; Aerator tip.
   2. SK2 (Benchtop Sink)
      a. Location: Procedure Room
b. Quantity: 1.
c. Material: 316L stainless steel, seamless, welded, ground smooth, satin #4 finish.
d. Overall sink dimensions: 24" long x 15" wide x 5/11" deep.
e. Marine edge: at front and sides of benchtop.
f. Backsplash: 12" high integral backsplash.
g. Faucet: Watersaver #CT414-9VB-BH- Hot/Cold faucet Colortech series; Satin chrome finish; Vacuum breaker; 9" swing gooseneck; Aerator tip.
h. Drying rack: 36" x 36" phenolic resin drying rack above each sink with polypropylene pegs. Drying rack to be mounted to two P3300 vertical stainless steel Unistrut at 24" on center, with phenolic resin shelf above, where noted on drawings.
i. Provide drain and tail piece. Connection to tailpiece per Div. 15.
j. Provide knee space below sink for ADA accessibility compliance.

3. SK3 (Surgery Prep Sink)
   a. Location: Surgery Prep Rooms.
   b. Quantity: 2.
   c. Model: Sloan ESS-3100.
   d. Material: 304 stainless steel.
   e. Overall sink dimensions: 32" wide x 40" high.
   f. Mount: wall mount.
   g. Sink faucet: Integral with sink.
   h. Provide drain and tail piece. Connection to tailpiece per Div. 22.

2.12 FUME HOODS

A. Manufacturer: Jamestown, or Kewaunee, or Labconco, or Mott.
B. Basis of Design model: Labconco Protector XL.
C. Sash opening: 18".
D. Air flow monitoring: Sash monitoring.
E. Prewired with single point power J box at top of fume hood and GFI Elec outlets at front sides.
F. Preplumbed with compressed air piping.
G. Liner: white polyresin.
H. Work surface: 1" black epoxy resin with marine edge on all four sides.
I. Baffle: fixed.
J. Sash design: Vertical rising sash with laminated safety glass, frameless, with full width flush pull.
K. Interior access panels: provide interior access panels at side walls of fume hoods.
L. Ceiling enclosure panel: provide ceiling enclosure panel at top of fume hood to enclose area between top of hood and ceiling.
M. Finish: Epoxy powder coat, white color.
N. Interior clear dimension: Interior clear dimension shall be a minimum of 27” from sash to back panel of fume hood.

O. Exterior depth: overall exterior depth of fume hood shall not exceed 36”.

P. Controls: fume hood controls are to be provided per Div. 15. General Contractor is responsible for coordination of all features of fume hoods between related divisions.

Q. General Contractor shall verify size, features, options, and all requirements of fume hoods with Owner’s Representative prior to purchase of fume hoods.

R. Fume Hood Schedule:
   1. CFH2 (4’ Accessible)
      a. Type: Variable Air Volume (VAV).
      b. Size: 4’ overall width.
      c. Location: Procedure Room.
      d. Quantity: 1.
      e. Prepiped services: Carbon dioxide piped from cylinder manifolds in Store Room.
      f. Prewired electrical power: 115v duplex outlet at each side of fume hood with GFI.
      g. Work surface height: 34” above floor.
      h. Base cabinets: None; accessible knee space below fume hood.

2.13 SAFETY SHOWER/EYEWASH

A. Manufacture: Watersaver.

B. Model: SSBF2160.

C. Type: Recessed Safety Station with drain pan and stainless steel shower head.

D. Drain: Provide hard pipe drain for eyewash per Div. 15. Do not daylight drain.

E. Shower head: Locate maximum of 96’ above finish floor.

F. Piping finish: All exposed piping shall be satin chrome finish.

G. Floor drain: Provide floor drain below safety shower per Div. 15. Do not slope floor to drain. Drain shall be flush or recessed no more than 1/8” below finish floor.

2.14 METRO SHELF UNITS

A. Furnished by Owner. Shown for reference only.

B. Location: Lab Storage/Stability Room.

C. Manufacturer: Metro


E. Finish: Chrome.

F. Casters: Metro 5MP polyurethane wheel rated at 300 lbs. for each caster; locking casters on all four legs.
G. Shelf: open wire type.

H. Shelf dimensions: 24" width by 48" length. Five (5) shelves per shelf unit, equally spaced top to bottom.

I. Post dimensions: 74-5/8".

2.15 GAS MANIFOLD

A. Location: Store Room.

B. Manufacturer: Spectra.

C. Model: F7910 Series with stainless steel regulators.

D. Quantity: Four. Two each for Oxygen cylinder gas; two each for Carbon Dioxide cylinder gas.

E. Features: Changeover Regulator; Line Regulator; Relief Valve; Flexible Hose Assembly; Pressure Gauges.

F. Overall Dimensions: 8.25" wide x 8.75" deep x 9" high.

2.16 CYLINDER RESTRAINT

A. Location: Store Room.

B. Material: Stainless steel.

C. Components: Stainless steel P1000 Unistrut horizontal member at 24" wide for each pair of cylinders at 36" and 18" above floor with welded link stainless steel chain sized for 9" diameter gas cylinder.

2.17 MOP RACK

A. Location: Vivarium Vestibule Corridor.

B. Model: AJW UJ12B.

C. Length: 36”.

D. Number of mop holders: 4.

E. Mount: wall.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set casework components plumb, square, and straight with no distortion and securely anchored. Shim as required using concealed shims and or leveling bolts.

B. Screw continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16” tolerance.

C. Secure wall cabinets to solid supporting backing material, not to plaster, lath or gypsum board.
D. Work Surface Installation: Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure joints in field, where practical, in the same manner as in factory, with dowels, splines, adhesive or fasteners recommended by manufacturer.

E. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer. Abut top edge surfaces in one true plane. Provide flush joints. Where required due to field conditions and top material, scribe to abutting surfaces.

F. Accessory Installation: Install accessories and fittings in accordance with manufacturer’s recommendations. Turn screws to seat flat; do not drive.

3.2 ADJUSTING

A. Repair or remove and replace defective work, as directed by Owner’s Representative upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.3 CLEANING

A. Clean shop finished casework, work surfaces, and accessories; touch up as required, wipe down and broom clean interior and exterior of equipment.

3.4 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent exposure of casework and equipment from exposure to other construction activity during installation.

B. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION
PART 1 - GENERAL

1.1 PURPOSE

A. The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV’s requirements in excess of ten years.

B. Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.

C. This specification is intended to provide general design guidelines for new construction, and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an electrical subcontractor under the general contract, the specifications included in this document are intended as supplemental information to insure an acceptable, effective installation.

1.2 CONTRACTOR QUALIFICATIONS

A. Contractor must possess a valid State of Nevada Contractor’s License and have successfully performed at least three projects of low voltage cable installation with similar size and work scope, within two years of the date of the job they are bidding on. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the start and end dates, and contact information. For projects that require a Request for Proposal this information will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

B. All contractor personnel who will be performing work on this project shall have been trained on the work they will be performing. They shall have been trained on the Contractor’s company policies with respect to personnel safety, telecommunications industry cabling quality and neatness standards, and use of Construction Standard Institute (CSI)-standard specifications and drawings.

C. Contractor, at all times during performance and until work is completed and accepted, shall have on the premises a competent supervisor, satisfactory to the Customer and with authority to act for the Contractor. The supervisor must be a BICSI certified Installer and BICSI member in good standing.

D. Contractor must have a current BICSI certified Registered Communications Distribution Designer (RCDD) on staff as a full-time employee as a requirement to bidding and performing awarded work. For projects that require a Request for Proposal the RCDD certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.
E. For jobs that require more than 24 data connections, weekly inspections and approval of all work performed shall be conducted by the contractor’s RCDD certified employee. The contractor will submit a weekly status report to the Customer detailing what work has been completed and inspected. The report will also include any issues encountered as part of the install. See Appendix 4.4 for report template.

F. Contractor must provide at least one lead technician on site at all times during project who is a BICSI certified installer and a BICSI member in good standing. For projects that require a Request for Proposal a copy of certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request must be provided with bidding documents.

1.3 APPLICABLE REGULATIONS

A. RELATED DOCUMENTS:

Equipment and material shall be Underwriter's Laboratories listed and labeled. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency.

1. ANSI/TIA-569-C Commercial Building Standard for Telecommunications Pathways and Spaces
2. ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
5. ANSI/TIA-568-C.3 Optical Fiber Cabling Components
6. ANSI/TIA-606-B Administration Standard for the Telecommunications Infrastructure of Commercial Building
7. ANSI/TIA-607-C Commercial Building Grounding and Bonding Requirements for Telecommunications
8. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling National Electrical Manufacturers Association (NEMA)
9. National Electrical Code, latest revision (NEC)
10. National Fire Protection Agency (NFPA) – 70
11. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
12. UL 497 Protectors
13. UL 1459 Standard for Safety for Telephone Equipment
14. UL 1863 Standard for Safety for Communications Circuit Accessories
15. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
17. UL 1581 Standard for Safety for Reference Standard for Wires, Cables and Flexible Cords
19. ANSI/EIA 310D

1.4 SUBMITTALS:

A. For jobs that require submittals, the Contractor shall furnish the following in a single consolidated submittal with an Approval copy to the Customer:
1. Contractor’s license number and proof of qualifications.
2. A copy of the RCDD certificate and BICSI member number as described in the above Contractor Qualifications section.
3. A copy of the BICSI certificate and the BICSI member number of the lead technician as described in the above Contractor Qualifications section.
4. A copy of the BICSI certificate and the BICSI member number of the supervisor as described in the above Contractor Qualifications section.
5. For all Category 6A and 6 installation technicians, provide the training certificates with a brief description of the training courses associated with each certificate.
6. Reference sheets which provide three references. Each reference shall include a brief description of the project, the start and end dates, and contact information.
7. A copy of a valid manufacturer certified installer certification.
8. The make and model of the materials to be used.

1.5 DESIGN REQUIREMENTS

A. Work must conform to the design requirement for each identified element.
   1. Building Service:
      a. Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for an air-blown fiber tube-cell conduit to enter through individual 4” conduits from the campus underground plant from two diverse locations. Exact air-blown fiber tube-cell conduit size will be determined by Network Development and Engineering on project by project basis. Voice cables (minimum 50 pair) to enter from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4” conduits to the campus underground plant for later use by UNLV after installation of all voice and data cables. All raceways to have 880 lb. nylon pull strings installed. All new service entrance conduits shall be a minimum 4" trade size and of sufficient number to provide 50% growth capacity, and will terminate 4” above finished floor in the MDF (main distribution frame) room inside the building.
      b. Service – Data
         1) Data communication service to each building shall consist of a minimum of 72 strands of 9.0/125-micron single-mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own air-blown fiber tube-cell conduit. Multi-mode and single-mode fiber is to be terminated with LC style connectors, UPC. Single-mode fiber will be terminated in a separate rack-mounted fiber optic enclosure. Contractor will install an air-blown fiber distribution unit in all MDF and IDF locations. Each fiber optic enclosure must be labeled with building, IDF room number and fiber enclosure identifier of opposing end. Patch panels to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. Service loops of fiber-optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirements, cable management will be provided by UNLV Network Development and Engineering.
c. Service – Voice
   1) Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper, 50-pair twisted cable. Cable to enter building through a separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue. Lightning protection to be provided as required per design specifications and/or applicable codes and regulations.

B. SERVICE ENTRIES
   1. Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100 volt range.
   2. Building entry conduit shall allow for 50% growth and have a minimum of four 4” conduits from manhole to MDF room.

C. MANHOLES
   1. All manholes shall be at minimum 4’ by 4’ by 4’ and encased in concrete. All cable is to have service loops and be racked and mounted. Each manhole will have drainage holes and be engineered so water will not accumulate. Top of manholes are to be flush with paved areas, or 6” above finished grade in landscaped areas.

D. CABLE SPLICING
   1. Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fibers optic strands of the exact make and model on each end using factory terminated connectors on pigtails. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices shall not be acceptable.
   2. The following cable splicing techniques and materials for copper cable shall be utilized:
      a. Preparation for Splices
         1) All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcast 4435 non-conductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcast 4414 or 4415 or UNLV approved equal.
      b. Splicing requirements
         1) No splice cases will be permitted in cable trays.
         2) All splice closures for use on underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
         3) End caps must be tapered and flexible and be capable of separate cable entries.
         4) Rigid bonding and strain relief bars must be an integral part of the finished closure.
         5) Re-enterable, polyurethane compound shall be used.
         6) All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
         7) Supports: All cable splices shall be supported by a minimum of two cable hooks. Horizontal racking for support may utilize 3M Brand RC-100 rack adapters, manhole racks, or University...
approved equivalent.

8) Closures: 3M splice closures or University approved closures will be used for splicing throughout the system.

9) Protection: All cable splices must be protected from damage at sheath openings by mechanically protecting all conductors utilizing 3M Scotchcast Pair Saver 4458 or approved equivalent.

E. BUILDING VOICE AND DATA TERMINAL ROOMS: All new building structures shall have minimum one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).

1. Main Distribution Facility (MDF) Specifications
   a. The MDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept clear of all other equipment.
   b. Each MDF will be provided with an isolated electrical panel with 200-amp service.
   c. The MDF will require the installation of a telecommunications main grounding busbar (TMGB) to the service equipment (power) ground with a conductor the same size as the largest telecommunications bonding backbone (TBB). The connections of the bonding conductor for telecommunications (BCT) and the TBB to the TMGB shall utilize exothermic weld, listed compression two-hole lugs, or two-hole exothermic lugs. All equipment racks shall be connected to the TGB with a telecommunications equipment bonding conductor (TEBC) that is continuous copper conductor not less than #6 AWG.
      The TMGB shall:
      1) Be provided with holes for use with correctly matched listed lugs and hardware.
      2) Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
      3) Have minimum dimensions of ¼ in. (6.35mm) thick by 4 in. (100mm) wide and shall be long enough to accept all current connections with additional room for growth.
      4) Be listed by authority having jurisdiction.
   d. Each MDF will have two quad 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs, two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs, and two 20 amp NEMA L6-20Rs. All outlets will require dedicated electrical circuits. When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks at standard outlet height.
   e. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36” wide and 80” high.
   f. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14’ x 10’, and not have false floors or ceilings.
   g. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
   h. A separate HVAC thermostat control will be installed for all MDF rooms, and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be
maintained with a minimum of one air change per hour.

i. All MDFs shall be secured using a UNLV-approved card access reader and striker.

j. All MDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.

k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

l. A minimum of two walls must be covered by backboards as defined in Part II.

m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

2. Intermediate Distribution Facilities (IDFs)

a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.

   Each IDF will be provided with a TGB connected by a TBB to the TMGB. The TBB shall be no smaller that a #6 AWG conductor and/or use the recommend sizes in accordance with ANSI-TIA-607-B. All equipment racks shall be connected to the TGB with a TEBC that is continuous copper conductor not less than #6 AWG.

   The TGB shall:
   1) Be provided with holes for use with correctly matched listed lugs and hardware.
   2) Be made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
   3) Have minimum dimensions of ¼ in. (6.35 mm) thick by 2 in. (50.8 mm) wide and shall be long enough to accept all current connections with additional room for growth.
   4) Be listed by authority having jurisdiction.
   5) Where a grounding equalizer (GE) is required it shall be bonded to the TGB.

b. Each IDF will have two quad 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will require dedicated electrical circuits.

   When available, all outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, at standard outlet height.

c. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36” wide and 80” high.

   Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 8’ x 10’, and not have false floors or ceilings.

d. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.

e. A separate HVAC thermostat control will be installed for all IDF rooms,
and shall be air conditioned with separate own zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.

f. All IDFs shall be secured using a UNLV-approved card access reader and striker, the access of which is to be managed by the Network Operations Center.

g. All IDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36” of clearance front and back and at least 24” on one side. OIT provided room drawings must be followed.

h. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.

i. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.

j. A minimum of two walls must be covered by backboards as defined in Part II.

k. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.

l. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

F. BUILDING INTERIORS

1. Underground Plant
   a. The cables from the underground plant shall enter the building in a MDF room. Appropriate wire management shall be installed such as ladder racks, D-rings, and hook and loop tape so as not to exceed the acceptable cable bend radius.

2. Data Rooms
   a. Additional IDF(s) shall be provided if necessary to prevent total length of data cable runs from exceeding 300 feet. Additional IDF rooms in multistory buildings shall be aligned vertically with the MDF room if possible.

3. Internal Backbones (Risers)
   a. A minimum of two 4” conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of single-mode fiber, as defined in Part II. Fiber optic cable is to be contained inside air-blown tube cell conduit. 12 Category 6 cables will be provided between every IDF and the MDF. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.

4. Station Wiring
   a. Data Outlets
      1) All outlets shall be constructed using single gang, 4-port faceplates, colored almond, or similar. All outlets shall have at least two network drops each.
      2) The ports on the left side of the faceplates will always correlate to an odd numbered patch panel port. The ports on the right side of the faceplates will always correlate to an even numbered patch panel port.
   b. Copper Cabling
      1) All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jack. Every cable shall be continuous and unspliced, with data
cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 300 feet. All cabling must terminate in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part II.

c. Habitable Space Provisioning
1) Every habitable space shall be provisioned a minimum of one data outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.

d. Non-habitable Space Provisioning
1) Every non-habitable space shall be provisioned with one data outlet every 500 ft², minimum of 1 per enclosed space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.

e. Labeling
The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable's origin and destination. Station identifiers shall match the corresponding patch panel port number for each drop. The drops will be in consecutive order whenever possible. They shall increment from left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Faceplate labels will be the manufacturer’s labels provided with the outlet assembly unless otherwise specified. The labeling schema shall be as follows:
1) All labels will be in the format of “310-306-1-24” Where “310” is the Station room number, “306” is the IDF, “1” is the Patch Panel identifier, and “24” is the port that the drop terminates to in the patch panel.
2) Cable Wrap labels:
   Wrap labels are required within 6 inches of the cable's termination point at both ends. Wrap labels will follow the format listed in this section, i.e. “310-306-1-24” Splitting this into two lines is acceptable in which case “310-306” would go on the first line and “1-24” would go on the second line. The font size will be the largest size that fits the required information but no smaller than 8 point font.

f. Station labels:
1) The Station label will follow the format listed in this section. However, the top label include both top ports i.e. “310-306-1-24, 25”. The first patch panel port number will always be the left face plate port and the second patch panel port number will always be the right face plate port. The bottom label will follow the same guidelines when used. When unused the label will be left blank. The font size will be the largest size that fits the required information but no smaller than 10 point font. See “Standard Outlet Configuration” in Appendix A2

UNLV Vivarium
June 17, 2016 – Permit Set

TECHNICAL GENERAL REQUIREMENTS

13700  Page 8
the patch panel in a place that is easily visible. Counting from the top of the rack down, the first installed patch panel will be identified with the number 1, the second with the number 2 and so on. The patch panel port label will be in the format listed above "310-306-1-24". Space limitations will require the label to be in two rows. The font size will be the largest size that fits the required information but no smaller than 8 point font. These labels should be center justified and located directly above the port they are labeling or in other manufacturer provided locations for port labels.

5. Wireless – 802.11
   a. Data cabling at wireless locations shall be terminated in electrical boxes that are mounted parallel to the ceiling, above the drop-ceiling grid panels. Two blue data cables shall be directly run from an IDF and will be terminated in data jacks. The jacks will be mounted in a faceplate and the faceplate will be mounted to the electrical box. These locations shall have a minimum clearance of 14” x 14” x 8” and will be mounted to a wall or secured to equipment that meets local NEC, ANSI/TIA-568-C, and ANSI/TIA-569-C standards. No cable run from IDF to connection point may exceed 300 feet.
   b. At each access point location, connect the access point to the horizontal cabling using contractor provided patch cords (see section 2.2.B for patch cable requirements). The cable that correlates to an odd numbered patch panel port will plug into the access point’s LAN port and the cable that correlates to an even numbered patch panel port will plug into the access point’s CONSOLE port. All patch cables will use appropriate J-hook/supports or dressing.
   c. Wireless locations that are placed in locations with a hard-lid ceiling will have the cables be terminated inside of the electrical box but not placed in a faceplate. The electrical boxes at these locations shall be 4 inch square boxes with a depth of 3 ¼, or 5-inch square boxes. Each box must maintain the minimum bend radius of the cable.
   d. Access point installations other than hard-lid locations will require the Contractor to use a Customer provided bracket. This will require the Contractor to cut a hole in drop ceiling acoustic tile. See Appendix A4 for an example of this install.

6. Wireless Access Point Placement and Wireless Overlay for 802.11. Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include but are not limited to the following:
   a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.
   b. Installations which require access points to use antennae other than the standard dipole antennae
   c. The finished ceiling plan is exposed and the customer has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building
   d. Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.

7. Cable Trays: All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.
   a. Supports: Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2" in diameter.
   b. Capacity: Cable trays shall be sized for a minimum growth of 50%.
   c. Grounding: Cable trays shall be grounded in accordance ANSI/TIA-607-B.
8. Cable Installation
   a. Copper
      1) Installation is to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C.
      2) All terminations are to follow ANSI/EIA/TIA 568-B.
      3) Completed installation is to be Certified Category 6 or 6A using the ANSI/EIA/TIA 568-C.2 testing standard or better. Test documents/results to be supplied to UNLV in .PDF format. Completed installation is to be approved by UNLV Network Development and Engineering.
   b. Fiber
      1) Installation is to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C. Fiber terminations will be completed using one of the following methods:
         a) No epoxy/no polish connectors
         b) Factory-terminated pigtailed with fusion splicing
      2) Single-mode will be terminated in a separate rack-mounted fiber optic enclosure.
      3) Completed installation is to be certified using ANSI/EIA/TIA 568-C.3 testing standard or better. Test documents/results to be supplied to UNLV in .PDF format. Completed installation is to be approved by UNLV Network Development and Engineering.

9. Pull and Splice Boxes
   a. Location
      1) Pull boxes must be installed in easily accessible locations. It is not permissible to locate a pull box in the ceiling for conduits larger than 2” in diameter. Conduits larger than 2” diameter, entering a box shall be routed down a wall or column and the box shall be installed accordingly.
      2) All pull boxes shall be placed in a straight section of conduit. Align the corresponding conduits at each end. All boxes shall be properly and adequately secured. They are not to be supported by the conduits entering the box. Install boxes for station cabling immediately above the suspended ceiling.
   b. Access
      1) Provide boxes with a suitable cover.

G. GROUNDING
1. Regulations
   a. All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC), ANSI/TIA-607-B, and all other applicable codes and regulations.

2. Installation Requirements
   a. Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.

3. Grounded Connectors
   a. Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweat when bolting. Avoid splices in bonding or grounding conductors. If splices are required they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas or water pipe as the grounding electrode.
PART 2 - PRODUCTS AND ACCEPTED MATERIALS

2.1 GENERAL

A. All material required for a complete installation shall be furnished by the Contractor unless otherwise specified by UNLV Planning and Construction Department.

B. All materials provided by the Contractor must be new, free from defects and must meet the Customer’s specifications. For projects that require a Request for Proposal, bidders shall submit the make and model of materials that will be used as part of their submittal. See section 1.3.

C. All fixtures and hardware must be installed as per requirements detailed in this document. No custom items shall be used except as reviewed and approved by the Network Development and Engineering. The contractor shall be held financially responsible for any work or re-work required due to improper approval and/or acceptance of that work performed which differs from the construction documents.

D. All products shall be new, and brought to the job site in original manufacturer’s packaging. Electrical components (including innerduct) shall bear the Underwriter’s Laboratories label.

E. All station cables shall be CMR Riser rated when entire cable runs are installed in conduit.

F. All station cables shall be CMP Plenum rated when any section of the cable run is not installed in conduit.

G. The Contractor shall inspect all products and materials prior to installation. Damaged cable or any other components failing to meet specifications shall not be used in installation.

2.2 BACKBOARDS

A. All backboards required in the IDF/MDF rooms shall be plywood, ¾”, 4’ by 8’ sheets, grade A, treated on one side with fire resistant paint or material, installed with finished side exposed.

2.3 CABLE SPECIFICATIONS

A. WARRANTY

1. All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. Vendors must be certified installers of the products they select for installation. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

B. APPROVED CABLELING MANUFACTURERS

1. Copper Installation:

   a. Vendors may select from the following list of approved copper cabling manufacturers:

   1) TE Connectivity
   2) Siemon
   3) Leviton
   4) Panduit

   Products selected from these vendors must meet requirements detailed in this document.
b. New Building: All copper installations in new buildings on campus will be completed using products from a manufacturer on the approved list. All cabling and components will be certified Category 6A / Class E and will meet all requirements listed Section 2.2-C.

c. Existing Building: In cases where vendors install cabling in existing IDF's, installers shall use open ports on existing category 6 patch panels. The warranty requirement listed in section 2.1-A will apply to these installations. This will require vendors to be certified installers for the existing components in the IDF. If there are no open ports, not enough ports to complete the job, the existing patch panel is not category 6, or the installer is not a certified installer of the existing components, then after approval from Network Development and Engineering staff, the installer shall install products from a manufacturer on the approved list.

2. Fiber Installations:
   a. Vendors may select from the following list of approved air-blown fiber cabling solution manufacturers where air-blown fiber is required:
      1) Future Flex Air-Blown Network Solutions by Sumitomo Electric
      2) Lightwave
      3) eABF solutions by AFL/Duraline
   b. Vendors may select from the following list of approved fiber cabling solution manufacturers where Air-Blown Fiber is not required:
      1) AFL
      2) TE Connectivity
      3) Siemon Leviton Panduit Corning
   c. Building to Building
      1) All fiber installations for building to building interconnects will use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
   d. New Building
      1) All fiber installations for new buildings on campus, including building to building interconnects and MDF to IDF connections will use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
   e. Existing Building
      1) All fiber installations for buildings with existing air-blown fiber infrastructure will be installed using use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
      2) All fiber installations for buildings without existing air-blown fiber infrastructure will be installed using traditional fiber cabling. Contractors shall install components from a manufacturer on the approved fiber manufacturer list.

C. DATA COPPER
   1. All copper data cable for existing buildings will be Category 6, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO Category 6 /Class E requirements. All copper data cable for new buildings will be Category 6A, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO Category 6A /Class F requirements. Only materials from accepted manufactures in section 2.1.B will be installed.
   2. Cables will be rated as plenum or riser based on installation requirements.

D. PATCH CABLES
   1. All patch cables installed by the contractor will be factory terminated and tested to meet requirements stated in section 2.2.C.
E. EXTERIOR CABLE
1. All telephone cable that supports devices external of a building such as emergency phones use Superior Essex cable part number 09-092-02, 6 pair buried drop.

F. SINGLE-MODE FIBER OPTIC
1. All single-mode fiber optic cable must be 9.0/125. All single-mode terminations are to be LC, UPC finish. A 12- or 24-fiber adapter panel must be used in the fiber optic enclosure.

G. AIR-BLOWN FIBER COMPONENTS
1. Tube cell count for tube-cell cabling will be determined by Network Engineering and Development Staff on a project by project basis.
2. All new building IDF's and MDF's will require the installation of fiber distribution boxes. Other locations such as manholes and other splice or junction locations will require fiber distribution boxes as needed.

2.4 DATA TERMINATIONS

A. COPPER DATA COMPONENTS
1. Patch Panels
   a. All data patch panels for existing buildings are to be modular, Category 6, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. All data patch panels for new buildings are to be modular, Category 6A, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6A/Class Ea requirements.
   b. Every group of 48 must be separated by 2U of horizontal cable management, Panduit part# WMPF1E. All cabling will route through the rear cable Management prior to termination in the patch panel. All terminations are to follow ANSI/EIA/TIA 568-B.

2. Voice Copper Termination Blocks
   a. All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.

3. Data Jacks
   a. All data jacks for existing buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements.
   b. All data jacks for new buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6A/Class Ea requirements.
   c. All terminations shall follow ANSI/EIA/TIA 568-B.

4. Faceplates
   a. All faceplates shall be 4 port, light almond (or vendor equivalent), single gang, low profile, with a window for labels. All unused ports must be covered with a blank insert.

B. FIBER OPTIC
1. Terminations
   a. Terminations will be completed with one of the two following methods:
      1) No epoxy/no polish connectors
      2) Factory-terminated pigtailed with fusion splicing:
         a) Fusion splices will be protected in splice cases or other suitable enclosures.
   b. Connectors
      1) Single-mode fiber is to be terminated with LC style connectors, UPC Polish.
c. Fiber enclosures
   1) TE Connectivity fiber optic enclosures models RMG-2000-000B or RMG-4000-000B will be used. RMG-4000-000B will be used when installing more than 24 fiber strands or at the request of network engineering. RMG-2000-000B will be used when installing 24 fiber strands or less. Equivalent enclosures can be approved by Network Development and Engineering on a case-by-case basis.
   a) Fiber Adapter Panels
      (1) Single-mode fiber will terminate in 12- or 24-fiber standard adapter panels.

2.5 DATA EQUIPMENT RACKS
A. All racks are to be four post, open frame, square hole, black, Panduit part number R4PCN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.6 CABLE TRAYS
A. All cable trays for distribution of data cables within a building are to be a minimum of 18” wide by 4” deep, solid trough or ladder and will be approved by UNLV Planning and Construction and Network Development and Engineering.

2.7 EXCEPTIONS
A. Due to unique constraints and requirements of existing IDFs, exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.

PART 3 - EXECUTION
3.1 The University has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part III - Execution.

3.2 Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the University to inspect certain material or work, shall mean that the University has the option, rather than the obligation, to do so. Any warranty or guarantee provisions contained in the Contractors'/Vendors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.3 DEMOLITION
A. COORDINATION WITH UNIVERSITY OPERATIONS
   1. No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.

B. WORK TO BE PERFORMED BY OWNER
   1. Upon notification by contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or out of service (dead). If station cabling is dead the technician will insure that all cross-connects have been removed. If the facilities to be moved or removed are
determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.

C. DISPOSAL OF SURFACE-MOUNT RACEWAY
   1. Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.

3.4 EXCAVATION

A. The Contractor shall be required to excavate for underground mechanical piping, and shall perform all auxiliary work that may be required to do so.

B. No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The University has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to Call Before U Dig. All lines damaged by Contractor will be repaired at Contractor’s expense.

C. Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight-line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.

D. All underground construction work, during progress and after completion, shall conform truly to lines and grades. If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.

E. The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

F. Contractor shall not obstruct the gutter of any street or driveways, but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.

G. Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.

H. Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.

I. Grass will be replaced by a method approved by the University.

J. Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.5 INSTALLATION

A. REGULATIONS
   1. All work and materials will comply with all federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.
   2. If there are violations of codes, the vendor will correct the deficiency at no cost to the University.
3. Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

B. QUALITY ASSURANCE
1. Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be completed to the satisfaction of UNLV Network Development and Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.

C. DAMAGE OF EXISTING FACILITIES
1. The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

D. COORDINATION
1. Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.
2. Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.
3. All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.
4. At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by University personnel, or where deemed necessary by the Contractor for securing materials.
5. Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

E. CABLE SUPPORT AND ANCHORS
1. All cables, wires and equipment will be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.
2. All data cables installed without conduit in plenum spaces will be secured using j-hooks or other Network Development and Engineering approved mounting hardware.

F. FIRESTOP SYSTEMS
1. A fire stop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Fire stop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate fire stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using state approved fire resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:
   b. ASTM E119: Methods of Fire Tests of Building Construction Materials
   c. ASTM E814: Standard Method of Fire Tests of Through-Penetration Fire stops
   d. ASTM C719: Adhesion and Cohesion of Elastomeric Joint Sealants
under Cyclic Movement.

e. ASTM C920: Standard Specification of Elastomeric Joint Sealants
f. UL 263: Fire Tests of Building Construction Materials
g. UL 723: Surface Burning Characteristics of Building Materials
h. UL 1479: Fire Tests of Through Penetration Fire stops
i. UL 2079: Standard for Fire Tests of Joint Systems

G. CONDUIT
1. Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical. Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.
2. All offsets shall be considered equivalent to a 90-degree bend.
3. Sections of conduit longer than 100 ft require a pull box.
4. Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.
5. Conduits entering the IDF through the wall shall be reamed or bushed, and terminated not more than 4 inches from the wall surface.
6. Conduits entering the IDF from below shall be terminated 4 inches above finished floor.
7. Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4” in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
8. Conduit installed for data and/or voice cabling may not be shared with any other cable.
9. All conduit runs for station outlets shall be not less than 1” in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.
10. After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.
11. Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.
12. Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8” in diameter.
13. Conduit shall not block access to existing services.
14. All junction boxes will maintain the minimum bend radius for the cable being installed. Special consideration should be taken concerning the use of Category 6A/Type EA cabling, data termination jacks, and the minimum bend radius with required eight (8) inch minimum excess cable at each outlet.
15. Pull boxes will be installed in position and relationship to adjoining work, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb, and straight edges.

H. CABLE INSTALLATION
1. All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer’s specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.
2. Any cable to be placed through an electrical room or any other potentially hazardous conditional shall be placed in conduit.
3. All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.
4. All data outlets will have a minimum of eight (8) inches of cable stored at each drop after the cable has been terminated.
5. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.
6. Cable supports are to be anchored in accordance with TIA 569-C and NEC.

7. Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.

8. All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building. Hook and loop tape is the only approved product for bundling cable. Tie-wraps will not be used bundle cable.

9. Installation to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C. UNLV Network Development and Engineering must approve completed installation.

I. CABLE TESTING: All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.

1. Copper Data Cable
   a. All Data cables shall be tested in accordance with ANSI/TIA-568-C.2. Balanced Twisted-Pair Telecommunications Cabling and Components Standard or better and best industry practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering.
   b. Testing: Each cable shall be tested for wire map, length and performance. The data cables shall be bi-directional tested using a ANSI/TIA 1152 level III or better cable analyzer. The cable analyzer shall be within the calibration period recommended by the manufacturer.
      1) Wire Map: Each pair of each installed cable shall be tested for continuity, opens, shorts, pair-reversals, split pairs, transposed pairs, and any other miss-wiring. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
      2) Length: Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.
      3) Performance Verification: Category 6 or 6A data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:
         a) Propagation Delay
         b) Delay Skew
         c) Insertion Loss
         d) NEXT (Near-End Crosstalk)
         e) PS NEXT (Power Sum Near-End Crosstalk)
            ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
f) PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
g) ACR-F (Attenuation to Crosstalk Ratio Far-End)
i) PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
j) Return Loss
k) TCL (Transverse Conversion Loss) – recorded for information only
l) ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only

4) Equipment
a) Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C.2 Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

2. Fiber Optic
a. Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C3 Standard, and the result shown as pass/fail. The test results shall include all tests performed and the actual test result achieved. All test results to be provided to the UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

b. Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-C.3, Optical Fiber Cabling Components.

c. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

d. The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor's test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the installers' cost.

e. Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

1) Single-mode
a) Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both
wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one-jumper reference, two-jumper test to estimate the actual link loss of the install cable plus two patch cords. Single-mode fiber optic cable must meet or exceed the following limits:

2) Attenuation: 0.4dB/km at 1310nm, 0.3dB/km at 550nm.
3) Connectors: Max loss for a mated pair of connectors shall be less than 0.5dB

3. OTDR
   a. Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with ANSI/TIA 568-C.2. The measurements to determine splice loss shall be performed in accordance with manufacturer’s recommendations and best industry practices.

4. As-Builts
   a. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and it's corresponding station side location. As-builts will be created from latest digital architectural drawings, to most closely resemble exact building conditions, as possible. Hand drawings are not acceptable. As-builts & test results must be provided in both .PDF and CAD format. Upon acceptance of contract, vendor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-builts & test results and subsequent corrected versions of those documents. Network equipment (Including Voice, Data and A/V services) will not be provisioned until this documentation is provided.

J. GROUND TESTING
1. Two-point ground and continuity testing will be performed to determine if there is an acceptable maximum level of resistance between any point in the telecommunications bonding and grounding system and the building’s electrical grounding electrode system.
   a. Prior to performing a two-point test, a visual inspection shall be performed to verify the bonding and grounding system is installed according to ANSI/TIA-607-B guidelines.
   b. For the test to be valid it must be done prior to the installation of the telecommunications equipment
   c. The recommended maximum value for resistance between any point is 100 milliohms.
   d. The following areas will be tested:
      1) TMGB/TBG to the electrical ground from each IDF/MDF.
      2) TMGB/TGB to the building steel (if present).
      3) TMGB to TGB
      4) Building steel (if present) to the electrical ground.
      5) The printed test results shall include all tests performed and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project.
3.6 CONTRACTOR SUMMARY

This summary is intended to provide an overview of key requirements that contractors of small data cabling installations will most often need to reference. Contractors will still be responsible for maintaining compliance with the entire wiring specification.

A. Contractor requirements
   1. Certified to install for one of the approved manufacturers.
   2. RCDD on staff
   3. Supervisor and/or lead installer shall be BCSI certified installers and members in good standing
   4. For required installations, RCDD will conduct weekly inspections and submit weekly status report to Customer.

B. Approved manufacturers
   1. Copper
      a. TE connectivity
      b. Leviton
      c. Siemon
      d. Panduit
   2. Fiber
      a. Air-blown fiber
         1) Future Flex Air-Blown Network Solutions by Sumitomo Electric
         2) Lightwave
         3) eABF solutions by AFL
      b. Non-air-blown fiber
         1) Corning
         2) TE Connectivity
         3) Siemon
         4) Leviton
         5) Panduit

C. Warranty
   1. All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

D. Cabling
   1. Copper Data Cabling and Components
      a. New buildings will be installed with Category 6A cable and components from one of the approved manufacturers.
      b. Existing building will be installed with Category 6 cable and components from one of the approved manufacturers.
      c. All data patch panels for existing buildings are to be modular, Category 6 or 6A, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class F requirements.
      d. All data jacks shall be modular, unshielded, 4-pair, 8P8C, Category 6 or 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class F requirements.
      e. Terminations will follow wiring scheme TIA568-B.
      f. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.
      g. Hook and loop tape is the only approved product for bundling cable.
      h. Tie-wraps will not be used bundle cable.
      i. Wire managers will be Panduit WMPF1E and WMPVHC45E
      j. Racks will be Panduit R4PCN
2. Fiber Cabling and Components
   a. Air-blown fiber tube cell conduit will be installed in all new buildings and in new building-to-building fiber installations.
   b. Air-blown fiber will be used in existing buildings that contain existing air-blown fiber components.
   c. Non-air-blown fiber will be used in existing buildings that do not have existing air-blown fiber components.
   d. Terminations will be completed using no epoxy/no polish connectors or factory-terminated pigtails with fusion splicing.
   e. All fiber will be terminated with LC / UPC connectors and be mounted in 12- or 24- fiber adapter plates.
   f. Fiber enclosures will be from a NDE-approved manufacturer. Adapter plates will of standard size and will fit these enclosures.

E. Documentation
   1. Labeling
      a. Contractor will be responsible for labeling all installed cables.
         1) The labeling scheme will use the format described in Appendix A2.
         2) Contractor will label the patch panel port, cable termination points, and faceplates.
         3) Contractor will also be responsible for labeling any new patch panel.

   2. Testing
      a. All installed cables will be certified by an approved cable analyzer.
      b. Test results will meet TIA-568-C.2 and TIA-568-C.3 requirements.
      c. Test results will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all test results prior to activating ports.

   3. As-builts
      a. All installed cables will be documented on an as-built diagram. The diagram will indicate the location and actual label of all installed cabling. As-builts will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all that the data contained the as-builts matches the actual labels prior to activating ports.
APPENDIX A – EXHIBITS

A1  Standard Conduit Routing

1 90 degree bend

1 Inch Conduit

Single Gang Box 1” conduit to cable tray

PLAN VIEW

ELEVATION VIEW

STATION BOXES

CABLE TRAY

FASTENED TO CABLE TRAY WITH BUSHING
### A2  Standard Labeling Scheme

**Room#-IDF#-patch panel#-port#**

Example 310-305-5-13  
This cable would terminate in room 310 and IDF 305 patch panel 5 port 13

**Faceplate Label:**

Follows format of Room#-IDF#- patch panel#-1\(^{st}\) port#, 2\(^{nd}\) port

The cable run of this jack is terminated at patch panel 5, port number 13 at IDF 305 and in room 310

**Wrap Label:**

Required within six inches of both termination points

Preferred: 310-305 5-13  
Acceptable alternate: 310 305 5-13

**Conduit:**

3/4" Diameter

This cable run of this jack is terminated at patch panel 5, port number 14 at IDF 305

**Data Jacks:**

Cat6, 8P8C, Black

**Blank Inserts:**

Match faceplate color

**Bottom Faceplate Label:**

Left blank unless bottom ports are used. If used, the bottom label will follow the top label’s format for 3\(^{rd}\) and 4\(^{th}\) ports

**Patch Panel Labels:**

Patch panels will be labeled as shown. The label will be a number unique to the rack. If it is the top patch panel in the rack it will be labeled 1. If it is the next patch panel down from the top it will be labeled 2 and so on.
A3  Example access point acoustic tile install
**UNLV Network Engineering Cabling Weekly Report**

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1. **What is the estimated project completion status? ____%**

2. **List any problems encountered during the review period and their resolution**

   1. 
   2. 
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3. **List rooms and/or portions of the project that were inspected during the review period**

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**UNLV Vivarium**  
**June 17, 2016 – Permit Set**
SECTION 13720
SECURITY ACCESS SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES: ELECTRONIC LOCKING SYSTEMS

A. RELATED SECTIONS
   1. 08710 - Door Hardware.
   2. 08740 - Door Schedule.
   3. 16050 - Basic Electrical Materials and Methods

B. References
   1. ANSI/BHMA A156.2 - Bored and Preassembled Locks and Latches.
   2. ANSI/BHMA A156.13 - Locks and Latches, Mortise.

C. Definitions Used with On-Line Electronic Access Control System
   1. Access Group: A list of access points and the time zone that users will be allowed access.
   2. Access Reader: Provides control of the access point by interfacing a card, electronic key, chip, or keypad with the system.
   3. Alarm Monitoring: Provides the system a status of the alarm devices.
   4. Distributed Architecture: Describes the operation of the system that allows the system to function with its normal routines without communications to the computers or other panels.
   5. Door Controller: Provides the system the interface of the reader and alarm inputs along with the relay outputs and communicates the information to the computer.
   6. Elevator Controller: Restricts user access to the floors by user access group.
   7. Operator Log-On: Computer operator that has been granted access to the system software by a user ID and password.
   8. Relay Control: Provides control of devices by time zones or linking events by the software.
   9. Site Controller: Provides the interface of 100 DCD’s (Door Control Device) and 10 RCD’s (Relay Control Device) with the computer.
   10. Site Ethernet Interface: Provides TCP/IP connectivity via an Ethernet network with any number of site control units.
   11. Time Zone: Start and end period along with days of the week that can be used to control user access, automatic unlocking access points, alarms inputs, reports, and relay operations.
   12. User: Holder of a card, Marlok key, Touch chip, or keypad ID.

1.2 SYSTEM DESCRIPTION

A. Password protected proximity card reader access to entire facility and individual rooms within the facility, as indicated on the drawings.

1.3 SUBMITTALS

A. Comply with Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including installation instructions.

C. Operating and Maintenance Instructions: Submit manufacturer's operating and maintenance instructions.
D. Warranty: Submit manufacturer’s standard warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   a. Responsible for all components.
   b. Continuously engaged in electronic access control system construction with a minimum of 15 years successful experience.
   c. Able to demonstrate successful performance on comparable projects.
   d. Responsible for system design, including:
      1) Preparation of engineering and production documentation.
   e. Development of testing program and interpretation of test results.
   f. Capability of providing manufacturer-employed field service personnel for installation assistance as required.
   g. Capability of providing 24-hour, 7 days per week technical service assistance through a toll free telephone number after acceptance of work by the Owner.
   h. Capability of providing manufacturer-employed field service personnel for technical service and maintenance after acceptance of work by the Owner.

B. Installer Qualifications:
   1. Trained in installation by manufacturer.
   2. Approved by manufacturer.

C. Pre-installation Meeting: Convene a pre-installation meeting two (2) weeks before start of installation of electronic access control system. Require attendance of parties directly affecting work of this section, including Contractor, Architect, installer, and manufacturer’s representative. Review installation, field quality control, adjusting, demonstration, and coordination with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials indoors, in a clean, dry area in accordance with manufacturer's instructions.

C. Handling: Protect materials and finishes during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

1. Millennium Group, Inc.
   16 Tech Circle
   Natick, MA 01760
   Phone: (866) 455-5222
   Fax: (508) 651-2902

2.2 ON-LINE ELECTRONIC ACCESS CONTROL SYSTEM: MILLENIUM ENTERPRISE


1. System shall have capability to perform:
   a. Access control.
   b. Alarm monitoring.
c. Identification badging.
d. Programmable relay control.
e. View events in real time.
f. Print selected events in real time
g. Controlled by a computer (Server)
h. Support Microsoft SQL Server 2005 through 2012
i. Control several segregated databases

B. Computer System Characteristics:
1. An off-the-shelf IBM or compatible that is readily available shall control system locally, where the Owner can obtain a maintenance contract on computer.
2. Processor: Pentium IV or better
3. RAM: 4 GB minimum.
4. Hard drive 30 GB minimum
5. Serial Ports (optional for use with direct wiring sites)
6. Accurate clock (1 to 5 Minutes per year) or network time service.
9. Communication: Computer shall communicate to system via a RS-232 serial port or RS-232 serial port and Lantronix Ethernet adapter to communicate via TCP/IP protocol
10. Monitor Resolution: Support a minimum resolution of 800x600 at 32,000 colors.
11. Hard Drive: For storage of events that have occurred on system.
12. A minimum of two (2) USB 2.0 or USB 3.0 ports.
13. CD-ROM. And/or DVD Drive

C. Software Design:
2. Use a GUI (Graphical User Interface) based upon Windows standards, including Windows theme support, have extensive context sensitive on-line help, and provide familiar icon-driven, tabbed dialog menu options.
3. Perform network communications tasks via a separate integrated application running in background.
4. Alarm monitoring, alarm editing, and setup applications shall require operator logon to function.

D. Operators Software
1. Limit system operator by default operator levels.
2. Capability of individual operator passwords for logging on.
3. Capability of infinite programmable operator levels. These levels shall be fully programmable as to menu items and functions available to an operator. Operators may have rights to view, add, change, delete, or execute over program features.
4. Provide an automatic operator logoff delay.
5. Require a logon ID different from operator name to maintain network security.
6. Require periodic password changes.
7. Allow system lockout if three wrong password attempts made.

E. Database:
1. Support the ODBC standard
2. Supplied with a full support of Microsoft SQL 2005/2008/2012 database server application to allow archiving of history, database repair functions, and import/export.
3. Support near-real-time import and export of data.
4. Support automatic update of user access rights as a result of import process.
5. Allow for a unique industry standard ISO card number to be generated on demand as part of import process.
6. Provide a Tenant partition feature; allows specific system entities in the database to be seen and manipulated only by certain "Tenant Groups". Such entities can be users, sites, doors, and elevator floors. When the database is divided into spheres of control in this way, operators in a given group (each one is called a "Tenant Group") will control data such as sites, doors, users, and access groups for their own group(s) only. The database itself is complete, but views are generated such that what the operator can view, add, modify, delete or print reports, is limited by the Tenant Group(s) to which they have rights to as well as by Operator level.
7. Provide “Tenant Wizard” to allow easy operator manipulation of tenant Group elements-users, doors, sites, and access groups

F. Alarm Monitoring Software:
1. Support a minimum of 7 supervised alarm inputs per door control Unit with time zone disable feature, and a programmable shunt delay timer from 0 to 255 seconds.
2. Supervision of alarm points can be either two (Alarm, Reset) or four state (Trigger, Reset, Open and Short) determined at software configuration.
3. Provide a forced-door entry with an ajar alarm. Forced-door alarm shall have a shunt delay timer of 0 to 255 seconds. Ajar alarm shall have a programmable delay timer of 1 to 255 minutes.
4. Support adding name of alarm in a field minimum of 19 characters and additional information about each alarm in a “notes” field.
5. Support prioritizing of alarms to 100 levels.
6. Support linking specific alarms to relay control devices.
7. Include a graphical alarm editing application that shall allow a user to define alarms including graphical maps. Animated icons shall be placed on maps to indicate standard alarm types such as fire and break-in. Four levels of zoom shall be provided for each alarm.
8. Require acknowledgment text so personnel monitoring alarms shall provide response information.
9. Include an alarm monitor application separate from main software which shall display alarms graphically in priority with which they were programmed. Application shall be able to be run from any workstation. Allow Alarm acknowledgment from any workstation with synchronization between workstations.
10. Provide alarm monitor with capability to display a user portrait in response to valid or invalid access attempts.
11. Provide alarm monitor with support for standard sound cards and wav files so user defined sounds can be played for alarms.
12. Log-off with password shall be required to quit alarm monitor.
13. Programmable requests for incident reports.
14. Support up to 4 floor maps per alarm input, available within one double click directly on the alarm reported on the alarm monitor

G. Client Guard Tour Software:
1. Include a guard tour or client tour application which can be run from any workstation on network.
2. Provide client tour application for up to 100 tours, with a maximum of 96 intervals each.
3. Types of Tours Available:
4. Global: Assigned to any individual card holder at time tour is selected.
5. Individual: Assigned to a card holder at time of creation.
6. Allow for selective filtering at device level, so as to allow multiple workstations to run different tours.

H. Scheduler; integrated software:
1. Fully configurable integrated module allowing scheduled actions for any access points
of the system, overriding the normal door unlock/lock set up
Unlimited number of schedules supported by each tenant group
2. Configurable actions;
   a. Unlock – Lock b. Shunt alarms
   b. Adjustable time granularity down to the minute
   c. Yearly, monthly weekly, daily or fixed recurrence pattern e. Auto delete
      schedule after it expires
3. Exportable schedule reports.

I. Analog CCTV Integrated Software Module Option-DVR:
   1. The CCTV module integrated into the Millenium system allowing the viewing of video
      recorded based upon alarm events.
   2. Automatically display the appropriate CCTV camera and record video instantly in
      response to an alarm.
   3. Allow search of recorded video by Millenium alarm event or by alarm time.
   4. From the Millenium CCTV screens it is possible to play back a recorded alarm or record
      from any camera.
   5. Millenium allows linking of its alarm events with a group of cameras.
   6. The CCTV interface is operable from any workstation or multiple workstations.
   7. DVR recording equipment from Pelco First Line is supported.

J. Biometrics Module Integration Option
   1. The Biometrics module shall seamlessly integrate into the Millenium system allowing
      programming fingerprint templates.
   2. The Suprema BioEntry series of readers is supported.
   3. The module allows a Wiegand code to be inputed by a user and stored at each reader
      which is sent to the door control device upon a valid fingerprint read.

K. Other Software Functions:
   2. Not allow duplication of user names or user ID.
   3. 18 predefined user identification fields, 30 configurable user ID field, and 1 “Note” page
      per user. Searchable fields are: last name, first name, Social Security number, ID
      number, department, title, card number, card type, and any of the 30 configurable user
      fields.
   4. Support multiple access reader technologies and protocol on same system
      simultaneously.
   5. Provide for multiple “lost card” entries so a lost access credential can be easily identified
      if used.
   6. Support “disable card” function for each access credential, with option to control
      activation and expiration dates in each tenant group if required.
   7. Support a door control unit address and text description name in a field minimum of 19
      characters.
   8. Support door control units that total an even or odd number on system.
   9. Support 2 relays included with each door control unit.
   10. Support unlocking a strike/magnetic lock automatically in accordance with a
       programmable time zone.
   11. Support unlocking a strike/magnetic lock device at a defined time, but only after first
       valid user accesses access reader.
   12. Capability of programming relay operating time for use with such items as a strike or
       magnetic lock, electric latch retraction devices, as well as gates of all types.
   13. Provide an audit trail programmable by date and time range, user(s), and access
       reader(s).
   14. Notify when status of a door or relay controller changes because of a communication or
       device problems.
   15. Support programmable reports viewed on monitor or printed.
   16. Support programmable reports on printer in real time.
17. Provide capability of sorting history events by time, dates, users, access readers, and operators. Up to 8 Advanced reports with configurable fields.
18. Have ability to print a “dossier” report, which includes a person’s portrait along with user selected database fields and notes.
19. Support simultaneously 2 custom ABA formats and 2 Wiegand formats for access readers.
20. Support combination access readers with one Wiegand output. Support custom Wiegand outputs from 0 to 50bits, including 32 bits, 37 bits, HID Corporate 1000 program, and Motorola 27 bits.
21. Support user pin number along with a card that is enabled by a time zone.
22. Support a door pin number that is enabled by a time zone.
23. Support anti-Passback modes (global or paired or timed).
24. Support card start and stop times for each Tenant Group assigned to a user.
25. Support relays that can be programmed to operate by a time zone, alarms, or by events linked to access points.
26. Have the Owner’s name encrypted and displayed on monitor.
27. Able to accept any facility code of card or chip provided. (0 to 31bit facility code)
28. Capability to automatically archive transaction data and be able to select dates of data being archived.
29. Capability of routing system history to workstations on network such that if desired, multiple alarm monitoring stations can be maintained, each with separate alarm displays.
30. Provide an option to run on a Windows supported TCP/IP network with the number of workstations controlled by license.
31. Provide option of communication to sites using TCP/IP and Millennium Site Ethernet Interface.
32. Advise and display on computer monitor status of door and relay controller(s) if communication or power is lost on system.
33. Minimum Enterprise Parameters:
   b. Each Site Control Unit: 100 access readers, 10 Relay Output boards
   c. Each system: 1,000 site controllers.
   d. Number of Tenant Groups: Unlimited.
   e. Number of Access Groups: Unlimited.
   f. Time Zones: 200 each with 4 intervals, per Tenant Group
   g. Holidays: 20 with capability to delete after date.
   h. Vacation Periods: 8 with start-end dates and times
34. Support system lockdown on programmable “Hot key” icon.
35. Unconditional- all programmed points locked down- no access by any card or token.
36. Conditional- only Master level users allowed access.
37. Support system lockdown as in 33.a, 33.b by pre-programming access point (device) groups and activating with right mouse click. Support linking any system alarm point or action with lockdown function.

L. System Hardware:
1. System shall be able to be configured from 1 to 100 access readers for each site control unit.
2. Controllers shall have capacity of memory support, including real-time clock for a minimum of 24 hours, in case of AC loss of power and battery backup is exhausted.
3. System shall use a 100% fully-distributed architecture in which system alarms, access, relays, and elevator control shall continue to function in a normal mode without computer communications, or communication to any other system panel.
4. Site controller shall be able to communicate to computer via EIA standard RS-232, RS-485, leased line, fiber optics, wireless Spread Spectrum modem, or with use of a Lantronix Ethernet Interface, via TCP/IP protocol.
5. Site controller shall have a local relay to monitor status of communications with door control units. In case of device failure relay will open, providing a means of triggering
an external monitoring device.

6. Site, door, relay, and elevator controller features shall have capability to be field upgraded by a firmware change. Such firmware upgrades shall be offered as needed to registered users on an exchange basis, labor not included.

7. Door controller shall support any Wiegand standard based readers in any bit format up to 50 total; bit patterns fully programmable within software.

8. Door controller shall read Dallas touch chip format directly without use of accessory devices.

9. Door control Unit shall have ability to read Marlok™ metal keys using Keylok™ and key readers without use of interface devices.

10. Example supported reader types include but are not limited to: Wiegand 13 bit to 50 Bit, Mag stripe, Bar Code, Proximity, Dallas Touchkey, Keypad, Biometrics, combination keypad with Wiegand/Proximity/Magnetic stripe.

11. Door control Unit shall be able to be programmed for custom ABA formats from PC software, including ability to ignore user specified characters in format.

12. Door control Unit shall be programmable to accept either normal or inverted strobe signals from ABA format readers.

13. Same door control Unit shall be programmed for all access reader technologies as specified by means of PC software.

14. Site control Unit shall buffer last 2,000 events from door controllers when computer communications has been lost or terminated.

15. Each door control Unit shall buffer an additional 2,000 events when site controller buffer has filled.

16. All system control Units shall have a built-in tamper alarm to detect when a cover to controller is removed.

17. Door Control Unit:

18. Request to Exit input.


20. Located within 10 feet (3 m) of access reader (Marlok) or as specified by other reader manufacturer.

21. Function at full capacity without communications to computer, and buffer events up to a maximum of 2,000 during this period.

22. Continue to function on battery backup at a minimum of 9 V DC.

23. Door and relay control Unit shall have Form C dry contact configuration.

24. Door and relay control Unit shall have relays with a minimum current rating of 30 V DC at 2 A with solid-state automatically resettable overcurrent protection for contacts.

25. Door control Unit shall have a relay that can be programmed by software for: Valid User, Auto Activate, First User Auto Activate, Any User, Rejected User, Dual Custody (2 valid token to be presented within 5 sec), or Alarm Options.

26. Relay control Unit shall have relays that can be configured by software for Time Zone Activation, Timed Activation, Timed Released, First Event Activation, and First Event Released and Last Person Out.

27. Relay on door controller shall have a programmable timer and settings in software for strike and magnetic lock operation.

28. Door and relay controller shall provide a dedicated tamper alarm to monitor opening of controller mounting boxes.

29. Site to door control Unit communication conform to EIA RS-485 for a recommended total cable length of 4,000 feet (1,524 m).

M. Power Supply

1. Battery backup capable of providing power for system during temporary AC power outage.

2. Provide an output to notify system when there is a loss of AC power

N. System Access Readers:

1. Wiegand Output Format Readers: Output of 26-bit Wiegand format or a custom bit configuration from 13 to 50 with configurable facility codes, FIPS 201 Compliant to 50
2. Example supported reader types include but are not limited to: Proximity, Mag Stripe, Bar Code, Wiegand, Dallas Touch Chip, Keypad, Biometrics, combination keypad with Wiegand/Proximity/Magnetic stripe.

3. ABA Format Readers: ABA, ABA inverted.

4. Dallas Touch: Read-only type, all digits.

5. Marlok Reader: Directly supported in rotating and non-rotating types. Operates with Optical Marlok key. Marlok rotating Keylok interfaces to all standard US mortise locksets from Falcon, Corbin, Russwin, Sargent, Schalge, Yale, and Adams Rite.

O. Door Control Device (DCD)
   1. Designed to control a single access point.
   2. Contains a real-time clock and sufficient memory to provide access control independent of main PC.
   3. Transaction history shall be automatically buffered when not on line with PC.
   4. Priority event buffer assures alarms are annunciated in a timely manner even if history buffer is full.
   5. Power: 9 to 14 V DC, supplied by central power supply; 80 to 110 mA, depending upon reader technology. 225 mA additional required during unlock of Marlok rotating cylinder (7 seconds maximum). Accessory relays require additional 20 mA each.
   7. Reader Technologies Supported: Marlok key, Wiegand card (any bit format up to 50), ABA/ISO Track 2, proximity, keypad, combination reader/keypad, Dallas TouchKey, biometrics.
   8. Reader Interfaces Supported: Marlok, clock/data, clock/data inverted, Dallas touch, Wiegand.
   9. History Buffer: 2,000 transactions.
   11. On-Board Memory and Clock Backup: 24 hours minimum.
   12. Maximum Users Stored in Memory: 10,000.
   13. Alarm Input Points: 7 total, 2-wire supervised, 2 or four state selectable (EOL resistor) including built-in door contact monitoring.
   15. Tamper Alarm: On-board switch.
   16. Output Relays: 2 each with Form C contacts rated 2 A, 30 V.
   18. Connectors: 5 mm plug-on screw terminal.
   19. Address Switches: Rotary, direct-reading 00 to 99.

P. Operating Environment:
   1. Between 14 degrees F and 104 degrees F (-10 degrees C and 40 degrees C).
   2. Less than 90 percent noncondensing humidity.
   3. Support T-TAP, Daisy Chained or in a Star Topology connectivity up to 4000'.

Q. Site Control Unit (SCU):
   1. Designed to control a maximum of 100 door control devices (100 Card Readers) and a maximum of 10 relay control devices (80 relay/outputs).
   2. Normally used for a single site or building, contains a real-time clock and sufficient memory to supervise site.
   3. Maximum of 1,000 site controllers can be addressed in a system.
   4. Transaction history is automatically buffered when not on line with PC.
   5. Priority event buffer assures alarms are annunciated in a timely manner even if history buffer is full.
   6. On-board switches select operational modes.
   7. Power: 9 to 14 V DC, supplied by central power supply; 50 mA standby, 90 mA maximum.
9. PC to SCU Communications Interface: RS-232, RS-485 4-wire, or TCP/IP.
10. SCU to DCD Communications Interface: RS-485 multi-drop 2-wire.
11. Modem Support: Hayes AT command set, 9,600 baud or greater.
13. History Buffer: 2,000 transactions.
15. On-Board Memory and Clock Backup: 24 hours minimum.
17. Tamper Alarm: On-board switch.
18. Connectors: 5 mm screw terminal.
19. Address Switches: Rotary, direct-reading 000 to 999.
20. Operating Environment: Between 14 degrees F and 104 degrees F (-10 degrees C and 40 degrees C) with less than 90 percent noncondensing humidity.
21. Support T-TAP, Daisy Chained or in a Star Topology connectivity

R. Relay Control Device (RCD):
1. Power: 9 to 14 V DC, supplied by central power supply; 35 mA standby current, 20 mA additional for each relay activated.
2. Memory and Clock Backup: 24 hours minimum.
3. Relay Outputs: 7 Form C contacts, rated 30 V DC maximum at 2 A.
4. Supervisory Function: Relay 0 on first board installed. Opens on system fault
7. Configuration Jumpers: J3, relay polarity select all 16 relays; J5, relay override select.
8. Address Switch: Rotary, direct-reading 0 to 9.
9. Operating Environment: Between 14 degrees F and 104 degrees F (-10 degrees C and 40 degrees C) with less than 90 percent noncondensing humidity.
10. Power Supply: Power: 120 V AC, 60 Hz, 2 A,
11. Fuses: 2 A AC input slow-blow, 8 A (battery output protection).
13. Battery Backup: 2 gelled lead acid cell, 6 V DC, 8.0 Ah, supplied with power supply.
14. Alarm Outputs: Cover tamper switch and AC or power supply failure (dry contacts).

S. Trunk Interface Unit (TIU):
1. Description: Trunk interface unit provides interface between RS-232 PC serial port and site controller(s).
2. Power: 120 V AC to 9 V DC power cube, 200 mA.
4. Output: RS-485, 2 or 4-wire in 5-pin screw terminal connector.
5. Indicators: LED type, power, transmit, receive.
6. Protection: Reverse DC polarity, communications surges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive electronic access control system. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install electronic access control system in accordance with manufacturer's instructions.
B. Install system at locations as indicated on the drawings.
C. Install door hardware as specified in Section 08710.
D. Install electrical wiring to on-line system components as specified in Section 16100.
E. Use manufacturers supplied hardware.
F. Replace defective or damaged components as directed by the Architect.
G. Furnish to the Owner all required keys and keycards.

3.3 FIELD QUALITY CONTROL
A. Test completed installation to verify each component of electronic access control system is properly installed and operating.

3.4 ADJUSTING
A. Adjust electronic access control system as required to perform properly.
B. Adjust locksets for smooth operation without binding.

3.5 CLEANING
A. Clean surfaces in accordance with manufacturer's instructions.
B. Use cleaners approved by manufacturer, as some cleaners may damage keylok/keyreaders.
C. Do not use abrasive cleaners.

3.6 DEMONSTRATION
A. Provide a maximum of two (2) consecutive days of on-site service by manufacturer.
B. Demonstrate system to Owner’s personnel.
C. Train Owner’s personnel in proper operation and maintenance.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. INCLUSIONS
   1. The provisions of the Conformed General Conditions, Special Conditions, and the Sections included under Division 01, General Requirements, are included as a part of this Section as though bound herein.

B. DRAWINGS
   1. The Drawings prepared for this Project are an outline to show where apparatus must go in order to harmonize with the building and installations of the various trades. Work must be installed in accordance with the Drawings insofar as possible. Drawings shall be carefully checked during the course of bidding and construction. If discrepancies, errors, or omissions are discovered prior to or during the construction phase, the contractor is responsible to notify the Architect immediately for interpretation or correction. The contractor is responsible for taking necessary measurements, including clearances for equipment that is to be furnished. The Owner shall reserve the right to make minor location changes of equipment where such adjustments are deemed desirable from an appearance standpoint. Such changes will be anticipated sufficiently in advance to avoid extra work or unduly delay progress on the Project.

1.2 SUMMARY

A. RELATED SECTIONS
   1. Section 01010 – Summary of Work.
   2. The provisions of the General Conditions, Supplementary Conditions, and Sections included under Division 13 and of Division 16 are included as part of this section as though bound herein.
   3. Refer to Specification Section 13700 – General Technical Requirements
   4. Detail drawings for additional information and installation requirements.
   5. Section 01630 – Product Substitutions.
   6. Section 07840 – Firestopping.
   7. Section 05400 – Cold-Formed Metal Framing

B. PERFORMANCE
   1. Provide the labor, materials, equipment, appliances, services and transportation, and perform the operations in connection with the construction and installation of the Work. Work shall be as herein specified and as denoted on the accompanying Drawings.

1.3 INTERPRETATION OF CONTRACT DOCUMENTS

A. PRECEDENCE
   1. Precedence of Project documents shall be as follows:
      a. If any discrepancy in the specifications, drawings (to include detail drawings and associated General/Sheet Notes) or matrix exists – the most stringent or highest quantity version has precedence.
      b. Resolve all discrepancies by written direction from UNLV Security Systems.

1.4 SYSTEM DESCRIPTION:

A. The Security Video Surveillance System consisting of:
1. Install all devices as indicated on the drawings and herein specified per manufacturers' recommendations unless otherwise noted. The system shall include all raceways, conductors, cameras, monitors, etc. tested, complete and operable. System acceptance shall be by UNLV Security Systems.

2. Unshielded twisted pair (UTP) Cat 6 copper cabling for Video, Data, and Power cable (see requirements within these specifications) to each camera – CMR and outside plant rated as required by standards and codes.

3. Stranded power cable to each camera – CMR and outside plant rated as required by standards and codes.

4. Multi-pair Cat 5 or Cat 5e cable for camera backbone cabling runs – CMR and outside plant rated as required by standards and codes.

5. Fiber optic cable for camera backbone cabling runs – CMR and outside plant rated as required by standards and codes.

6. Raceways, cabinets, conduits, junction boxes, and service boxes.

7. Fixed and Pan/Tilt/Zoom (PTZ) cameras and related mounting equipment and housings.

8. Cabling and associated termination blocks and equipment.

9. Backbone conduits and/or conduit sleeves installed at each low voltage service backboard location as specified in the electrical plans and electrical drawings.

1.5 SUBMITTALS

A. SCALED DRAWINGS (Shop Drawings)
   1. The Contractor shall provide one (1) electronic copy of the Shop Drawings. The electronic copy shall be on a CD or DVD in AutoCAD and Adobe Acrobat PDF formats.

B. MANUFACTURER’S PRODUCT DATA (Product Submittals)
   1. The Contractor shall provide one (1) electronic copy of the product submittals. The electronic copy shall be on a CD or DVD in Adobe Acrobat PDF format.

1.6 PATENTS AND COPYRIGHTS

A. The Contractor shall protect, indemnify and hold University of Nevada Las Vegas and their agents harmless against any claims, suits, or proceedings for patent, trademark, copyright, or franchise infringement arising out of, or resulting from, the installation or use of the equipment, service, supplies and/or materials provided for this Project. The Contractor shall further agree to pay all expenses arising from such claims, suits, and proceedings, including costs of investigation, reasonable attorney fees, expert witness fees, damages, and/or any other litigation-related expenses, and shall further pay any and all royalties, settlements, or judgments for which University of Nevada Las Vegas or their agents may be liable as a result of any such litigation, claims, suits or other proceedings.

1.7 ACCEPTABLE MANUFACTURERS

A. These specifications are based on equipment produced by or for specific manufacturers.

B. It is not the intent of these specifications to limit or restrict submission of proposals for products by other manufacturers, but to set a baseline of operational functions and equipment standards. The contractor may submit proposals for the use of products by other manufacturers where product designation includes, "or equal".

C. The Owner will provide the final judgment regarding the products listed by the apparent low bidder in their materials list submittal. See Section 01630 for product substitution procedures.
1.8 INSTALLING CONTRACTOR QUALIFICATIONS – SECURITY VIDEO SURVEILLANCE

A. Installing Contractor must have a minimum of three (3) years previous experience in video surveillance / closed-circuit television (CCTV) systems.

B. Full-time regular employees of the successful, pre-qualified technology Contractor must perform all work on this Project. In the event a subcontractor is used/required for any part of the Project, the subcontractor shall also be a pre-qualified technology Contractor.

1.9 COORDINATION – OWNER FURNISHED MATERIALS

A. REPLACEMENT OF DAMAGED MATERIALS
   1. Once the Owner furnished materials have been signed for and received in good working order by the Contractor, the following will apply to cases where the material is later damaged:
      a. It will be the Contractor’s responsibility to replace any damaged products in their possession. In cases where one of the devices mentioned in Part 1.7.A.1 of this specification is damaged after receipt from the Owner, the damaged item shall then be returned to the Owner.

B. OWNER – CONTRACTOR COORDINATION FOR THE DISTRIBUTION OF MATERIALS
   1. Contractor shall be responsible for installing equipment quantities as shown in the Architect’s/Engineer’s drawing set. Equipment make/model/part numbers are project specific and may not match those identified in the detail drawings. Contractor shall be responsible for verifying installation requirements of Owner furnished equipment prior to equipment installation. The Contractor shall install products according to manufacturer’s recommended installation instructions if specific direction is not provided in the electrical drawings (Contract Drawings) or these specifications.
   2. Owner furnished materials will be available for pick up no sooner than 90 days prior to substantial completion of the project. The Contractor shall request a pickup address from UNLV Security Systems in writing via the Architect at least fourteen (14) business days (excluding UNLV holidays) prior to their proposed pickup date. UNLV will not be held responsible for any delays attributed to the Contractor failing to follow these requirements.

1.10 INTEGRATION GUIDE

A. GENERAL
   1. UNLV Security Systems will be providing an Integration Guide to the Contractor which identifies point to point termination requirements for the components of the Security Video Surveillance System. This guide encompasses the following information:
      a. Termination location for the 25 pair (multi-pair) cable on the S110 termination blocks which the cable will already be routed to.
      b. Termination locations for the Cat 6 camera cable on S110 blocks.
      c. Patching ports for Category 6 patch cords.
      d. Labeling requirements at the S110 blocks.

B. DELIVERY
   1. The Integration Guide will be available to the Contractor 150 days prior to substantial completion. The Contractor shall request a pickup address from UNLV Security Systems in writing via the Architect at least seven (7) business days (excluding UNLV holidays) prior to their proposed pickup date. UNLV will not be held responsible for any delays attributed to the Contractor failing to follow these requirements.
      a. Contractor shall notify UNLV Security Systems (in writing) of any changes or additions which would have a direct affect on the design. The changes will have to be integrated into the guide and additional materials may need to be ordered by the Owner.
PART 2 - PRODUCT STANDARDS

2.1 FUNCTIONAL REQUIREMENTS

A. To provide the Owner with the maximum flexibility, this Specification is intended to be a performance specification built around the successful construction and operation of the Security Video Surveillance system for this project. The Security Video Surveillance system consists of cable and associated termination equipment required to connect cameras to their designated power supplies and video head end equipment as necessary for a fully functional system. Contractor shall provide all devices and materials not identified as “Owner Furnished” in this specification. Utilize outside plant rated cable whenever cable runs are routed through conduit under grade or outside the building envelope. All products, Owner furnished and Contractor furnished, installed as part of this specification shall be under warranty by the Contractor for a duration of one (1) year for performance and workmanship. Any Owner furnished materials which fail due to negligence on the part of the Contractor shall also be considered covered under the one (1) year warranty for performance and workmanship. All products which are Contractor furnished and installed as part of this specification shall be under warranty by the Contractor for a duration of one (1) year for performance, materials and workmanship. This guarantee shall cover the replacement of all parts and labor to replace same made necessary by normal usage and wear.

2.2 SPECIFICATIONS (VIDEO CONTROL EQUIPMENT) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED MATERIALS

A. When installing the Security Video Surveillance system, the Contractor shall install products according to manufacturer’s recommended installation instructions if specific direction is not provided in the electrical drawings (Contract Drawings) or these specifications.

1. POWERED VPD (VIDEO, POWER, DATA) COMBINER
   a. Install Powered VPD Combiners as required by design. The Combiners are used to combine Video, PTZ data, and camera power over a single 4-pair UTP cable.

   INSTALL QUANTITY OF: (refer to electrical drawings – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED)

2. CAMERA POWER SUPPLY
   a. Install Camera Power Supplies as required by design. Power Supplies are used to provide power to the Security Video Surveillance cameras.

   INSTALL QUANTITY OF: (refer to electrical drawings – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED)

2.3 SPECIFICATIONS (CAMERAS) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED MATERIALS

A. Contractor shall reference Contract drawings for quantities and locations of cameras in addition to any other requirements stated under the description of each device in this section. The Contractor shall install products according to manufacturer’s recommended installation instructions if specific direction is not provided in the electrical drawings (Contract Drawings) or these specifications.

1. FIXED CAMERAS
   a. Install fixed cameras as required by design. The cameras shall be installed in locations shown in the electrical series of the contract drawings. Confirm types, quantities, and method of mounting with the UNLV Security Systems.

   b. If any discrepancy in the specifications, drawings or matrix exists – the most stringent or highest quantity version has precedence.
c. In cases where it does not appear the specified mounting for a camera will work in a given area, notify UNLV Security Systems in writing.

INSTALL QUANTITY OF: (refer to electrical drawings – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED)

2. PAN / TILT / ZOOM (PTZ) CAMERAS
   a. Install pan / tilt / zoom cameras as required by design. The cameras shall be installed in locations shown in the electrical series of the contract drawings.
   b. If any discrepancy in the specifications or drawings exists – the most stringent or highest quantity version has precedence.
   c. In cases where it does not appear the specified mounting for a camera will work in a given area, notify UNLV Security Systems in writing.

INSTALL QUANTITY OF: (refer to electrical drawings – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED)

2.4 SPECIFICATIONS (CAMERA HOUSINGS AND MOUNTING HARDWARE) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED MATERIALS

A. When installing the Security Video Surveillance System, the Contractor shall use the following listed manufacturer. Substitution of other manufacturer’s products in place of the listed manufacturer will not be allowed.

1. MANUFACTURER: SONY
   a. INDOOR RECESSED PLENUM HOUSING
      1) Provide Indoor Recessed Plenum Housings as required by design. The housings are used to install Security Video Surveillance cameras in ceiling / soffit spaces. Use Sony Part No. UNIILD3C3.

      PROVIDE QUANTITY OF: AS REQUIRED

   b. INDOOR CEILING OPEN FRAME KIT
      1) Provide Indoor Ceiling Open Frame Kits as required by design. The kits are used to install Security Video Surveillance cameras in ceiling / soffit spaces. Use Sony Part No. YTICB45.

      PROVIDE QUANTITY OF: AS REQUIRED

   c. CORNER MOUNT ADAPTER
      1) Provide Corner Mount Adapters as required by design. The adapters are used to mount Security Video Surveillance cameras on the outside corners of a building. Use Sony Part No. UNICMA1.

      PROVIDE QUANTITY OF: AS REQUIRED

   d. PENDANT BRACKET
      1) Provide Pendant Brackets as required by design. Use Sony Part No. UNIMDB3.

      PROVIDE QUANTITY OF: AS REQUIRED

   e. GOOSENECK WALL MOUNT BRACKET
      1) Provide Gooseneck Wall Mount Bracket as required by design. Use Sony Part No. UNIWMB4.

      PROVIDE QUANTITY OF: AS REQUIRED
f. MOUNTING BELL
   1) Provide Mounting Bell as required by design. Use Sony Part No. MDPDH120.

   PROVIDE QUANTITY OF: AS REQUIRED

g. MOUNTING GASKET
   1) Provide Mounting Gasket as required by design. Use Sony Part No. UNISSCGKT.

   PROVIDE QUANTITY OF: AS REQUIRED

h. GOOSENECK WALL MOUNT ADAPTER
   1) Provide Gooseneck Wall Mount Adapters as required by design. Use Sony Part No. UNIWMB1.

   PROVIDE QUANTITY OF: AS REQUIRED

i. POLE MOUNT ADAPTER
   1) Provide Pole Mount Adapters as required by design. The adapters are used to mount Security Video Surveillance cameras to rounded light poles. Use Sony Part No. UNIPMA1.

   PROVIDE QUANTITY OF: AS REQUIRED

2.5 SPECIFICATIONS (VIDEO SURVEILLANCE CABLE) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED MATERIALS

A. When installing the Security Video Surveillance System, the Contractor shall use the following listed manufacturer. Substitution of other manufacturer’s products in place of the listed manufacturer will not be allowed.

B. All Video Surveillance System Cable shall always be installed in conduit.

1. MANUFACTURER: TE CONNECTIVITY
   a. CATEGORY 6 CABLE (RISER)
      1) Provide a TIA/EIA 568 rated Category 6 UTP compliant, four pair riser cable from each camera location to the TR or ER location as required by design and/or local codes. Cable jacket color is to be blue. Use TE Connectivity Part No. TE620R-BLXX (where XX is length).

      PROVIDE QUANTITY OF: AS REQUIRED

b. CATEGORY 6 CABLE (OUTSIDE PLANT)
   1) Provide a TIA/EIA 568 rated Category 6 UTP compliant, four pair outside plant cable from each camera location to the TR or ER location as required by design and/or local codes. Cable jacket color is to be black. Use TE Connectivity Part No. TE620OSP-BK02. For cables runs over one-thousand feet (1000’) use TE Connectivity Part No. TE620OSP-BK06 or TE620OSP-BK10 for required length.

      PROVIDE QUANTITY OF: AS REQUIRED

2. MANUFACTURER: WEST PENN WIRE
   a. CAMERA POWER CABLE (RISER)
1) Provide a stranded 14 AWG, 2 conductor (black, red) stranded cable from each camera to the designated ER or TR Security Camera backboard as required by design and/or local codes. Use West Penn Wire Part No. C206-BK/RD.

PROVIDE QUANTITY OF: AS REQUIRED

2) Camera power cable shall not be routed between the ER and any TR.
3) The power cables’ construction shall be rated for its intended use.

3. MANUFACTURER: WEST PENN WIRE
   a. CAMERA POWER CABLE (OUTSIDE PLANT)
      1) Provide a stranded 14 AWG, 2 conductor (black, red) stranded outside plant rated cable from each camera to the designated ER or TR Security Camera backboard as required by design and/or local codes. Use West Penn Wire Part No. AQ226.

PROVIDE QUANTITY OF: AS REQUIRED

2) Utilize outside plant rated cable whenever cable runs are routed through conduit under grade or outside the building envelope. Indoor rated cable may be used for cameras mounted to the outside of the building envelope, provided the cable is not outside in conduit for more than a distance of five (5) feet. Outside plant rated cable shall ALWAYS be used when routed underground through conduit, regardless of the distance.
3) Camera power cable shall not be routed between the ER and any TR.
4) The power cables’ construction shall be rated for its intended use.

4. MANUFACTURER: WEST PENN WIRE
   a. CAMERA POWER CABLE (OUTSIDE PLANT) – UNDER SLAB / GRADE
      1) Provide a stranded 12 AWG, 2 conductor (black, red) stranded outside plant rated cable from each camera to the designated ER or TR Security Camera backboard as required by design and/or local codes. Use West Penn Wire Part No. AQ227.

PROVIDE QUANTITY OF: AS REQUIRED

2) Utilize outside plant rated cable whenever cable runs are routed through conduit under grade or outside the building envelope. Outside plant rated cable shall ALWAYS be used when routed underground through conduit, regardless of the distance.
3) Cameras not being installed on the building structure which houses the designated ER or TR for that camera shall have a power cable run to them. This would include mechanical and/or service yards and light poles in the parking lot, bus parking, and/or courtyards. Provide a stranded 12 AWG, 2 conductor (black, red) outside plant rated cable for the power cable for these cameras.
4) Camera power cable shall not be routed between the ER and any TR.
5) The power cables’ construction shall be rated for its intended use.

2.6 SPECIFICATIONS (VIDEO SURVEILLANCE BACKBONE CABLE) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED

A. When installing the Security Video Surveillance System, the Contractor shall use the following listed manufacturer. Substitution of other manufacturer’s products in place of the listed manufacturer will not be allowed.
   1. MANUFACTURER: GENERAL/TO BE DETERMINED
      a. 25-PAIR (MULTI-PAIR) CABLE (OUTSIDE PLANT)
1) Provide outside plant 25-pair (multi-pair) cable for use as the backbone cable for the Security Video Surveillance system. Utilize outside plant rated cable whenever cable runs are routed through conduit under grade or outside the building envelope. Cable shall also have an overall shield protecting all bundled pairs. Provide and install 25-pair (multi-pair) cable for use as the system backbone cable. Cable shall be UL Verified Category 5 and meet or exceed Category 5 requirements in ISO/IEC 11801 and EIA/TIA 568A. Contractor shall submit a cable for approval by UNLV – Security Systems.

2) Contractor shall review the Contract Drawings to determine available conduit pathway(s) when selecting cable type.

PROVIDE QUANTITY OF: (refer to electrical drawings –

b. 25-PAIR (MULTI-PAIR) CABLE (RISER)
   1) Provide riser rated 25-pair (multi-pair) cable for use as the backbone cable for the Security Video Surveillance system. Utilize riser rated cable whenever cable runs are routed overhead in conduit between the Equipment Room and a Telecommunications Room. At no time shall the cable be routed in conduit underground or outside the building envelope. Cable shall be UL Verified Category 5 and meet or exceed Category 5 requirements in ISO/IEC 11801 and EIA/TIA 568A. Contractor shall submit a cable for approval by UNLV – Security Systems.
   2) Contractor shall review the Contract Drawings to determine available conduit pathway(s) when selecting cable type.

PROVIDE QUANTITY OF: (refer to electrical drawings –

2. MANUFACTURER: TE CONNECTIVITY
   a. MULTI-MODE FIBER OPTIC CABLE (RISER)
      1) Provide a 6-strand, multimode riser fiber optic cable for use as the backbone cable for the Security Video Surveillance system. Use TE Connectivity No. 6-1553342-4.
      2) Contractor shall review the Contract Drawings to determine available conduit pathway(s) when selecting cable type.

PROVIDE QUANTITY OF: AS REQUIRED

b. MULTI-MODE FIBER OPTIC CABLE (OUTSIDE PLANT)
   1) Provide a 6-strand, multimode outside plant fiber optic cable for use as the backbone cable for the Security Video Surveillance system. Utilize outside plant rated cable whenever cable runs are routed through conduit under grade or outside the building envelope. Use TE Connectivity Part No. 6-1553387-4.
   2) Contractor shall review the Contract Drawings to determine available conduit pathway(s) when selecting cable type.

PROVIDE QUANTITY OF: AS REQUIRED

2.7 SPECIFICATIONS (TERMINATION BLOCKS AND WIRE MANAGEMENT) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED

A. When installing the Security Video Surveillance System, the Contractor shall use the following listed manufacturer. Substitution of other manufacturer’s products in place of the listed manufacturer will not be allowed.
1. MANUFACTURER: SIEMON
   a. S110 TOWER MODULAR JACK PANELS
      1) Provide a 300-pair (36 Cat 5e ports) modular jack panel kit as required by design. Use Siemon Part No. S110MB5-300JP.

      PROVIDE QUANTITY OF: (refer to electrical drawings –

   b. VERTICAL CABLE MANAGERS
      1) Provide a large-scale vertical cable manager for use with 300 pair tower as required by design. Use Siemon Part No. S188-300.

      PROVIDE QUANTITY OF: (refer to electrical drawings –

   c. HORIZONTAL CABLE MANAGERS
      1) Provide a metal duct for horizontal cable management at the base of the 300 pair towers and vertical cable managers as required by design. Use Siemon Part No. S188-WD.

      PROVIDE QUANTITY OF: (refer to electrical drawings –

2. MANUFACTURER: CHATSWORTH
   a. ACTIVE CEILING ENCLOSURE
      1) Provide ceiling enclosure as required by design. Use Chatsworth Part No. A1222-HR.

      2) System shall include wire supports, duplex electrical receptacle, patch panel mounting brackets (depending on model) and all other accessories required by the manufacturer for a complete installation.

      PROVIDE QUANTITY OF: AS REQUIRED

3. MANUFACTURER: TE CONNECTIVITY
   a. FIBER OPTIC CABLE INTERCONNECT CENTER (WALL MOUNT)
      1) Terminate all strands of the fiber optic cable at the Equipment Room and Telecommunication Room location. One (1) wall mount fiber interconnect center shall be installed in each location as shown in the drawing details. Use TE Connectivity Part No. WMG-2000-00B.

      2) When landing multimode LC terminations in a patch panel, use black, six (6) duplex LC aqua adapters. Use TE Connectivity Part No. RMG-12ADPQ2.

      3) For high-density fiber termination situations, when landing multimode LC termination in a patch panel, use black, twelve (12) duplex LC aqua adapters. Use TE Connectivity Part No. RMG-24ADPQ4.

      4) Additional adapter locations that are not filled using an LC adapter plate, should receive a blank adapter plate. Use TE Connectivity Part No. RMG-00ADP00.

      PROVIDE QUANTITY OF: AS REQUIRED

2.8 SPECIFICATIONS (TERMINATION HARDWARE) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED

A. When installing the Security Video Surveillance System, the Contractor shall use the following listed manufacturer. Substitution of other manufacturer’s products in place of the listed manufacturer will not be allowed.

   1. MANUFACTURER: TE CONNECTIVITY
a. CATEGORY 6 PATCH PANEL (FOR ACTIVE EQUIPMENT CEILING ENCLOSURES)
   1) Where Category 6 UTP cables are terminated in an active equipment ceiling enclosure, terminations shall be mounted in a patch panel. Provide Category 6 patch panels as required by the Active Equipment Ceiling Enclosure layout details in the Detail Drawings. For TE Connectivity – use quantity of two (2), 1 RMU, twenty-four port patch panels for each 48-port patch panel listed in the Drawing details. Use TE Connectivity Part No. TPNP-NNC10-NN (24-Port Patch Panel 1U Unloaded). In the Active Equipment Ceiling Enclosure, the Contractor shall install the cable strain relief provided by the manufacturer.
   2) Terminate each category 6 cable to patch panel with one (1) black Category 6 RJ-45 snap in jack. Use TE Connectivity Part No. 6830 1 830-04.
   3) Terminate fiber optic cable to patch panel with one (1) LC keystone jack for every two (2) strands of fiber. Use TE Connectivity Part No. 6645-1-172-01.
   4) Terminate fiber optic cable as required with an LC connector. Use TE Connectivity Part No. 6754483-4 or 1918385-3 for simplex terminations. Use TE Connectivity Part No. 6754485-4 or 1918388-3 for duplex terminations.
   5) Provide black blank modules as necessary to fill all unused positions of the patch panel. Use TE Connectivity Part No. 6645 1 160-04.

   PROVIDE QUANTITY OF: AS REQUIRED

b. CATEGORY 6 OUTLET (VIDEO MONITOR)
   1) Terminate each category 6 outlet designated for a video monitor with one (1) yellow, Category 6 RJ-45 snap-in jack. Use TE Connectivity Part No. 6830 1 830-08.
   2) Coil each category 6 outlet designated for a video monitor in designated 12”X12X6” pull box. Provide fifteen feet (15’) of spare cable in pull box.
   3) Provide ivory blank modules as necessary to fill all unused positions of the faceplate. Use TE Connectivity Part No. 6645 1 160-02.

   PROVIDE QUANTITY OF: AS REQUIRED

c. FACEPLATE
   1) Provide each video monitor outlet at +18” A.F.F. (unless noted otherwise in the drawings) with an ivory, single-gang, four port, angled faceplate at each location not using the Wiremold 4000 series. Use TE Connectivity Part No. 6644 1 174-02.
   2) When installing plates in the Wiremold 4000 series, utilize the appropriate TE Connectivity faceplate.

   PROVIDE QUANTITY OF: AS REQUIRED

d. MULTI-MODE FIBER OPTIC CABLE TERMINATIONS (LC)
   1) Terminate all multimode fiber optic cables as required with a LC connector. Land the LC connectors in a LC adapter in locations where a TE Connectivity wall mounted fiber interconnect center is specified in the contract documents. Use TE Connectivity Part No. 6754483-4 or 1918385-3 for simplex terminations. Use TE Connectivity Part No. 6754485-4 or 1918388-3 for duplex terminations.
   2) Use fiber fan out kit for fiber strand terminations if necessary for proper terminations of connector ends.
3) For installation of outside plant rated fiber optic cable, clean any residue from cable prior to termination.

PROVIDE QUANTITY OF: AS REQUIRED

2.9 SPECIFICATIONS (TERMINATION DEVICES AND PATCH CORDS) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED

A. TWISTED PAIR VIDEO BALUN
   1. Install a twisted pair video balun as required by design. Reference the electrical drawings for installation requirements.

   INSTALL QUANTITY OF: (refer to electrical drawings – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED)

B. CATEGORY 6 PATCH CORDS
   1. Install category 6 patch cords as required by design. The Cat 6 patch cords are used to support the connections required for each camera and remote video monitor that is a part of the Security Video Surveillance System.
   2. Patch cords shall be installed at the following locations:
      a. Between the S110 punch block and the VPD Combiner.
      b. Between two S110 punch blocks for cross-connecting.

   INSTALL QUANTITY OF: (refer to electrical drawings – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED)

2.10 SPECIFICATIONS (MISCELLANEOUS TOOLS AND ACCESSORIES) – CONTRACTOR FURNISHED, CONTRACTOR INSTALLED

A. TOOLS AND ACCESSORIES

   PROVIDE QUANTITY OF: SIX (6) EACH

   2. Use an Ideal Barrier Strip Part No. 89-610 for Security Camera backboard locations. Install barriers strips above camera power supplies’ upper knockouts.

   PROVIDE QUANTITY OF: (refer to electrical drawings)

PART 3 - EXECUTION

3.1 GENERAL

A. Perform this Work in accordance with acknowledged industry and professional standards and practices, existing building conditions, and as specified herein. Provide and install all materials, devices, components, and equipment as specified for a complete, operational system.

B. Maintain a competent supervisor and supporting technical personnel, acceptable to the Owner, during the entire installation. Change of the supervisor during the Project shall not be acceptable without prior written approval from the Owner and the Architect.
C. Coordinate all efforts with those of related trades. In the event of any conflicts, delayed or improper preparatory work by others, notify the Architect and Owner. The Owner’s decision will be binding. Verify all field conditions.

D. WORK INCLUDED
1. The Work covered under this Section of the specifications consists of furnishing all labor, equipment, supplies and materials, and in performing all operations as necessary for the fully complete installation of components that meet District and industry standards and are compliant with the Specifications and the accompanying Drawings, except as specifically noted otherwise.

2. The Work shall include, but not be limited to, the following:
   a. Furnish and install conductors and cables as specified.
   b. Furnish and install all punch blocks and related cable management.
   c. Furnish, install, and terminate copper cabling as required and specified.
   d. Furnish and install connectors (terminate cable) as specified.
   e. Furnish and install conduit and related boxes as specified.
   f. Install cameras as specified.
   g. Install the Security Video Surveillance electronics and hardware.
   h. Install and connect all other components which are Owner Furnished as specified.

3. Refer to the electrical drawings and the Security Video Surveillance system detail drawings which delineate camera locations, Security cabinet locations, and backboard termination locations.

E. WORK EXCLUDED
1. Conduit / raceways, electrical boxes, pull boxes, etc. and associated power required for the low voltage systems that are to be installed by the electrical contractor under other Sections of these Specifications.

F. PERMITS AND INSPECTIONS
1. Obtain all permits and inspections required by all legal authorities and agencies having jurisdiction for the Work. This shall be a part of the Work of the Contractor performing the Work requiring the permit or inspection.

3.2 INSTALLERS
A. All system equipment installations and tests are to be made by workmen skilled in the specific trades.

3.3 INSTALLATION
A. GENERAL
1. Coordinate cable terminations with respect to layout and arrangement with Owner prior to any terminations.
2. Contractor shall provide proper backing and any necessary straps/supports for camera mounts as required by code and/or seismic conditions.
3. Tamper proof mounting hardware shall be used for all camera installations.
4. Each monitor location shall have a yellow jack installed in the faceplate and labeled “SECURITY CAMERA ONLY”.
5. Use weather stripping for sealing exterior bell boxes to camera mounts as required.
6. The Contractor shall provide and install a 2'X2' access hatch for any location where a camera pull box or service box is installed above a non-accessible ceiling. Non-accessible ceiling space is defined as a location where the service or pull box is installed more than three (3') feet away from nearest accessible ceiling or access panel. Space between the access point and the service or pull box shall be free from any obstructions.
7. Pull boxes used for cable service loop shall be located no farther than fifteen (15') feet
from security camera location.

8. Allegheny “Tampruf” series of security screws and stainless steel cover plates shall be used on all exposed service boxes.

9. Allegheny “Tampruf” series of security screws shall be used on any existing electrical condulets (LBs) or for any new installations of Smart Pathway’s low-voltage LBs.

10. The Contractor shall use Velcro and/or d-rings to manage cable on the Security Camera backboard of the ER and each TR.

11. Utilize outside plant rated cable whenever cable runs are routed through conduit under grade or outside the building envelope. Indoor rated cable may be used for cameras mounted to the outside of the building envelope, provided the cable is not outside in conduit for more than a distance of five (5) feet. Outside plant rated cable shall ALWAYS be used when routed underground through conduit, regardless of the distance.

12. For conduits used by the Security Video Surveillance System, the maximum cross-sectional area fill of conduits shall not exceed 40% of the internal area of the conduit.

13. All cable runs are to be continuous without splices unless otherwise specifically identified in the contract drawings by UNLV Security Systems. The Contractor shall request approval from UNLV Security Systems in writing for any locations requiring a splice, but not already identified in the drawings.

14. Terminate all wiring on specified termination products (products identified for that particular use by the manufacturer). Utilize proper tools for specified system.

15. All wiring is to be free from grounds, shorts, crossed pairs, polarity reversals, and opens. All open/unused conductors shall terminated with approved terminations.

16. Owner Furnished baluns with unused conductors shall have each conductor terminated with a UR connector.

17. Security Video Surveillance system cable discovered during construction, by the Owner, to be excessively bent, crushed or kinked, submerged in standing water, supported in a method other than those identified in this Specification Section, subjected to excessive pulling tension, improperly managed during pulling so that the cable sheath has torn open or been significantly damaged, improperly terminated so that cable sheath and internal conductors are damaged, or otherwise mishandled in a method not supported by industry standards shall be clearly marked or severed by the Owner or Owner’s Representative. The Contractor shall then be responsible for immediately removing, discarding and fully replacing the marked or severed cable at the Contractor’s Expense and shall be solely responsible for all cost/time associated with any demolition or construction efforts needed to ensure that the cable is removed and replaced prior to substantial completion of the Project. This requirement shall be binding regardless of the construction project completion status when the damaged cable is discovered by the Owner/Owner’s representative. A credit for cable that has been mishandled in a method not supported by industry standards shall not be acceptable by the Owner or the Owner’s representatives.

18. Coordinate locations of cameras to ensure that camera views are not obstructed by ceiling equipment, wall hangings, landscaping, lighting, etc. It will be responsibility of the Contractor to coordinate installations of cameras with the other trades to gain the most unobstructed view from each camera location shown on the electrical series of security camera drawings. If a camera view is found to be obstructed during Proof of Performance testing, the contractor will be required to relocate the camera to gain the intended view of the camera. This requirement shall be binding regardless of the construction project completion status when the obstructed camera view is discovered by the Owner/Owner’s representative.

19. Electronic Access Control (if applicable), Intrusion Detection, or other low voltage systems shall not run in the same conduit or in pull boxes of the Video Surveillance System.

20. Penetrations through fire-rated assemblies shall be fire-stopped as specified in Section 07840.

21. Power for all Security Camera Equipment shall be on a circuit connected to the site emergency power generator (electrical contractor) or Central UPS as required by
22. Install quad receptacles flush in wall for each Security Camera backboard identified in the electrical series of security camera drawings and the electrical drawings. Each receptacle shall be on its own dedicated circuit. Contractor shall also provide a dedicated circuit for each receptacle being installed in the Security Camera cabinet identified in the electrical drawings. Reference electrical drawings for additional information.

23. Power for all Security Camera system backboards and cabinets shall be routed in Electrical Metal Tubing (EMT) conduit or Rigid Metallic Conduit (RMC), as required by design. Metal clad (MC), aluminum armored (AC), armored clad, flexible metal conduit (BX) cables will not be acceptable.

24. Security camera backbone and horizontal cables shall never be routed in the same conduit pathway.

25. Install mule tape in all conduits for future cable pulls.

26. Security camera service/pull boxes shall never have more than one extension ring installed for ease of servicing and accessing the security camera cables.

27. Security camera backbone and/or horizontal conduit pathways shall never be supported by any type of wire.

28. Pull/service boxes 12”X12”X6” and larger shall have hinged style covers when installed in a ceiling space.

29. Identify service box and pull box locations that are installed above the ceiling with a permanent purple mark on the ceiling grid or ceiling surface. Coordinate with UNLV Security Systems during installation for locations of identification marks.

30. Coordinate most direct route to security camera locations specified as “HD” to ensure that cable length does not exceed 295 feet. If a “HD” camera cable length is found to be over distance, the contractor will be required to provide a more direct conduit pathway to the camera location to achieve the required length. This requirement shall be binding regardless of the construction project completion status when the over length cable is discovered by the Owner/Owner’s representative.

31. The contractor shall reserve the top three Siemon S110 jack panels for backbone multi-pair cables at each security camera backboard. The contractor shall begin the termination of the horizontal video surveillance category 6 cables on the fourth Siemon S110 jack panel from the top. If the quantity of horizontal cables terminating at a security camera backboard exceeds seventy-two (72) cables, then the contractor may use the top three jack panels for termination of the horizontal cables.

32. Prior to commencement of any Work, the Contractor shall perform a pre-project proof of performance test of the existing security camera system(s) for the project in the presence of the UNLV Security Systems Department. The Contractor shall provide documentation of the results of the pre-project proof of performance test to the UNLV Security Systems Department.

33. The Contractor shall be responsible for the maintenance and operation of the existing security camera system(s) throughout the course of construction for the project.

34. Prior to the acceptance of the existing security camera system(s) at the project location by the UNLV Security Systems Department, the Contractor shall conduct a post-project proof of performance in the presence of the UNLV Security Systems Department. The post-project proof of performance test shall match the pre-project proof of performance test. If the post-project proof of performance test does not match the pre-project proof of performance test, the Contractor shall be solely responsible for making all necessary repairs to the system(s) in order to successfully pass the post-project proof of performance test.

35. Contractor shall install all Owner Furnished products as identified in the contract drawings.

B. POWERED VPD (VIDEO, POWER, DATA) COMBINER

1. Install Powered VPD Combiners as required by design on the designated Equipment Room or Telecommunications Room security camera backboard.

2. Install patch cables from S110 tower modular jack panels as required to provide video,
power, and data to each camera location.

3. Install patch cables from Powered VPD Combiner to S110 tower modular jack panels as required to provide video and data from each Telecommunications Room backboard to the Equipment Room through the multi-pair backbone cable.

4. Contractor shall ensure that all Security Video Surveillance system cabling is compliant with the manufacturer’s installation instructions.

5. Contractor shall ensure that all Security Video Surveillance system 4-pair UTP cabling is terminated T568A.
   a. Reference the electrical drawings for additional requirements.

C. CAMERA POWER SUPPLY
   1. Install Camera Power Supplies as required by design on designated Equipment Room and/or Telecommunications Room security camera backboard.
   2. Secure Camera Power Supplies to backboard using the correct mounting hardware.
   3. Terminate camera power cables to Camera Power Supply terminals using required spade lug connectors. No more than one camera power cable shall be terminated per set of Camera Power Supply terminals.
   4. Provide power for each camera as designated on the electrical drawings.
      a. Reference electrical drawings for additional requirements.

D. CAMERA HOUSINGS AND MOUNTING HARDWARE
   1. Install camera housings and mounting hardware as required by design.
   2. Provide proper backing and any necessary straps/supports as required by code and/or seismic conditions.
   3. The contractor will be required to modify camera mounting hardware to accommodate the installation requirements as shown on the electrical drawings.
   4. Install conduit, service boxes, pull boxes, fittings, etc. for a complete conduit pathway from each camera location to its designated security camera backboard as required by the electrical specifications, codes and regulations previously referenced in the construction specifications for this Project. Reference the electrical drawings for additional requirements.
   5. If any discrepancy in the specifications or drawings – the most stringent or highest quantity version has precedence.

E. FIXED CAMERAS
   1. Install fixed cameras as required by design.
   2. Install analog and HD fixed cameras using the specified mounting hardware as required on the electrical drawings.
   3. Install conduit, service boxes, pull boxes, fittings, etc. for a complete conduit pathway from each fixed camera location to its designated security camera backboard as required by the electrical specifications, codes and regulations previously referenced in the construction specifications for this Project. Reference the electrical drawings for additional requirements.
   4. Terminate cables for fixed cameras as shown on the electrical drawings.
   5. If any discrepancy in the specifications, drawings or matrix exists – the most stringent or highest quantity version has precedence.

F. PAN/TILT/ZOOM (PTZ) CAMERAS
   1. Install PTZ cameras as required by design.
   2. Install PTZ cameras using the specified mounting hardware as required on the electrical drawings.
   3. Install conduit, service boxes, pull boxes, fittings, etc. for a complete conduit pathway from each PTZ camera location to its designated security camera backboard as required by the electrical specifications, codes and regulations previously referenced in the construction specifications for this Project.
   4. Terminate cables for PTZ cameras as shown on the electrical drawings.
5. If any discrepancy in the specifications, drawings or matrix exists – the most stringent or highest quantity version has precedence.

G. CAT 6 CABLE INSTALLATION
1. Provide and install one (1) blue (or black if OSP rated), Category 6 UTP cable from specified camera locations to the designated Equipment Room or Telecommunications Room Security Camera backboard.
2. In the Equipment Room or Telecommunications Room, terminate the blue (or black if OSP rated), Category 6 UTP cable on the S110 tower modular jack panels.
3. At each camera location terminate the blue (or black if OSP rated), Category 6 UTP cable with an 8 position, 8 pin modular plug.
4. Termination method shall be the T568A wiring scheme at jacks, S110 termination blocks, and 8 position, 8 pin modular plugs.
5. It is extremely important for the Contractor to terminate the colored pairs properly. Improper termination of the designated pair carrying power (where applicable) may damage a camera. Reference the electrical drawings for camera cabling/wiring requirements.
6. For the Active Equipment Ceiling Enclosure, terminate each cable installed in the 24 port patch panel. Termination method shall be the T568A wiring scheme at the jacks and 8 position, 8 pin modular plugs.

H. 25 PAIR (MULTI-PAIR) CABLE INSTALLATION
1. Provide and install 25-pair (multi-pair) cable for use as the Security Video Surveillance system wiring backbone cable. Cable shall be UL Verified Category 5 and meet or exceed Category 5 requirements in ISO/IEC 11801 and EIA/TIA 568A.
2. Provide and install multi-pair cable from the security camera backboard in each designated Telecommunications Room to the Equipment Room security camera backboard as noted on the Security Video Surveillance detail drawings.
   a. Refer to the electrical drawings for additional information regarding the quantity of 25-pair (multi-pair) cables to be installed between each Telecommunications Room and the Equipment Room. Terminate on S110 modular jack panels at both ends as specified. Reference the Security Video Surveillance Integration Guide for location of termination on blocks.

I. FIBER OPTIC CABLE (MULTI-MODE) INSTALLATION
1. Provide and install multi-mode fiber optic cable for use as the security camera system backbone cable as required by design. Cable shall have a glass size of 50/125 microns and meet the Laser Optimized Multi-mode Fiber specifications in ANSI/EIA/TIA 492AAAC as well as the OM3 specifications in ISO/IEC 11801 2nd Edition and EN50173 2nd Edition. When using breakout cable sub-assemblies of 2.0 or 1.5 mm in diameter, crimp connector to breakout cable jacket or provide fan-out boot kits for all terminations. Fiber optic cable shall be cleaned and void of any water/liquid blocking gel/compound prior to termination into a fiber interconnect center.
2. Terminate all strands of the laser-optimized multimode fiber optic cable at each end with LC type connectors and land those terminations as required by design.
3. Provide and install laser optimized multi-mode fiber optic cable from each Active Equipment Ceiling Enclosure (LC snap-in jack) and Telecommunications Room (Fiber Interconnect Center) to the Equipment Room (Fiber Interconnect Center).
   a. For fiber optic cable routing between the Equipment Room and Telecommunication Room(s), terminate all strands of the laser-optimized multimode fiber optic cable with LC type connectors and land those terminations in the appropriate fiber optic cable interconnect center.
b. In the Active Equipment Ceiling Enclosures, terminate all strands of the six-strand laser-optimized multimode fiber optic cable at the enclosure end with LC type connectors and land those terminations in LC snap-in jacks in the plug-n-play patch panel. Terminate all strands of the six-strand laser-optimized multimode fiber optic cable at the Telecommunications Room or Equipment Room end with LC type connectors and land those terminations in the appropriate fiber optic cable interconnect center.

4. Refer to the Security Camera System detail drawings for additional information regarding the position and layout of the fiber optic cable terminations.

5. Innerduct shall be installed for the following fiber optic installations:
   a. Innerduct shall be installed for the purpose of providing a continuous, protected cable route for fiber optic cable whenever fiber optic cable exits the Active Equipment Ceiling Enclosure, Telecommunications Room or Equipment Room. Minimum innerduct sizing shall be one (1”) inch. Innerduct shall not be considered a substitute for conduit or conduit sleeves when required by specification, drawings or code.
   b. Innerduct shall be installed for the purpose of providing a continuous, protected cable route for fiber optic cable whenever fiber optic backbone cable is routed through conduit outside the building envelope (exterior rooftop conduit run, underslab conduit installation between buildings, etc.). Minimum innerduct sizing shall be one (1”) inch. Innerduct shall not be considered a substitute for conduit or conduit sleeves when required by specification, drawings or code.
   c. When innerduct is used for the routing of fiber optic cable between the Active Equipment Ceiling Enclosure, Telecommunication Room and/or the Equipment Room, the innerduct shall be terminated within the Telecommunications Room and/or the Equipment Room at the Cross Member Radius Drop directly above the fiber interconnect center that the fiber will be terminated into and shall be securely fastened to the ladder tray.

6. Refer to the Security Camera System detail drawings for additional information regarding the position and layout of the fiber optic cable terminations.

J. FIBER OPTIC CABLE (INTERCONNECT CENTER) INSTALLATION
   1. Provide and install one (1) wall mounted Fiber Interconnect Center in each location where a Wall Mount Fiber Optic Cable Interconnect Center installation is required by the design of the security camera system.
   2. Contractor to provide all components and other materials to ensure that the interconnect centers are installed according to the manufacturer's directions.
   3. Refer to the Security Camera System detail drawings for additional information regarding the specific installation location of the interconnect center(s) within the Telecommunications Room, Equipment Room or other locations.

K. CAMERA POWER CABLE INSTALLATION
   1. Provide and install a 12 or 14 AWG, 2 conductor (black, red) cable to designated cameras as required by design. Contractor shall terminate one end of the cable on the designated Ideal barrier strip on the security camera backboard and the other end to the camera. Reference electrical drawings for termination requirements of each camera.
      a. Contractor shall connect the red conductor to positive (+) connector and black conductor to negative (-).
      b. Contractor shall use a matching gauge jumper wire for all cameras that are designated to be terminated at the camera power supplies.

L. ACTIVE EQUIPMENT CEILING ENCLOSURE INSTALLATION
   1. Provide and install one (1) equipment enclosure in each location where an Active Equipment Ceiling Enclosure installation is identified in the detail drawings and/or on the project plans.
2. The electrical contractor shall install two (2) duplex electrical receptacles in the Active Equipment Ceiling Enclosure integrated junction box. The electrical contractor shall connect these receptacles to the central UPS subpanel or a panel supported by the Site Generator. If connected to the central UPS, use red duplex receptacles and a red cover plate per electrical specifications. The electrical power installation for this enclosure shall conform to all electrical specifications, codes and regulations previously referenced in the construction specifications for this Project.

3. Install as shown on drawings and in accordance with approved shop drawings.

4. Reference the electrical drawings for additional information.

5. Coordinate installation with suspended acoustical ceiling work. Contractor shall horizontally and vertically center the Active Equipment Ceiling Enclosure in the acoustical ceiling tile.

6. Contractor to provide all components and other materials to ensure that the Active Equipment Ceiling Enclosures are installed according to the manufacturer’s directions and the requirements of local building code.

M. LABELING

1. All cable terminations shall be clearly and permanently labeled with appropriate cable numbering. Attach labels with the writing along the length of the cable; “flags” will not be permitted. Labeling of termination system shall be provided on white labels. All labeling shall be black typed lettering. Labels shall be installed on cable two inches from the end of the cable. Reference Electrical Drawings for additional information. Hand written labels shall not be permitted.

2. Contractor shall be responsible for identifying and installing the correct labels to be used based on the surface the labels must adhere to. The label shall be installed with legible type, without any wrinkles, overlapping, or folds in the label obscuring the writing. Any label found to not be adhering to itself or the surface it is attached to (i.e., cable, device, cabinet, etc.) or having illegible type shall be replaced. The Contractor shall then be responsible for immediately removing, discarding and fully replacing the loose or illegible labels at the Contractor’s expense and shall be solely responsible for all cost/time associated with any construction efforts needed to ensure that the label is removed and replaced prior to substantial completion of the Project. This requirement shall be binding regardless of the construction project completion status when the non-compliant label is discovered by the Owner/Owner’s representative. The System will not be accepted by UNLV Security Systems until all labeling is completed and correct per this specification and/or the Electrical drawings.

3. The intent of the cable labeling is to simplify troubleshooting of like wiring types so the Security Video Surveillance cables can be traced from each camera to the room containing its designated ER or TR.

   a. For the Category 6 UTP cable – Typical Camera, follow the methodology as listed below:
      1) The first group of characters shall identify the room number where the cable originated from.
      2) The next group of three digits shall identify the camera number (as identified on the electrical security camera drawings and Camera Matrices).
      3) The next group of characters shall identify the type of camera (PTZ or FIX). If camera is an HD camera an additional set of characters shall follow the type of camera that shall read, “HD.”
      4) There shall be a dash between the room number, camera number, and camera type.
      5) Both ends of the cable shall be labeled. The cable end terminating at the camera location shall be labeled in the camera housing and also in the camera’s service box.

   b. For the 12-2 or 14-2 AWG power cable – follow the methodology as listed below:
1) The first group of characters shall identify the room number where the cable originated from.
2) The next group of three digits shall identify the camera number (as identified on the electrical security camera drawings and Camera Matrices).
3) The next group of characters shall identify that the conductors are being used for power by labeling with a “PWR”.
4) There shall be a dash between the room number, camera number, and “PWR”.
5) Both ends of the cable shall be labeled. The cable end terminating at the camera location shall be labeled in the camera housing and also in the camera’s service box.

c. For the Category 6 patch cables—follow the methodology as listed below:
1) The first group of digits shall identify the camera number.
2) The label shall be attached just below the boot.
3) Both ends of the cable shall be labeled.
4) If cable does not have a boot, the label shall be attached to the sheath just below the point where the outer sheath of the cable ends.
5) If more than one camera address is being transferred via the cable, then the label shall designate each camera address with a comma separating them.

d. The S110 block labeling scheme shall be provided to the Contractor upon delivery of the Integration Guide. The sequence of labeling would be difficult to follow without the Integration Guide present.

N. SERVICE LOOPS
1. Service box (4-11/16” square): Contractor shall provide three (3”) inches of service loop measured from conduit fitting to end of cable for all 4-11/16” square service box locations.
2. Service box (12”X12”X6”): Contractor shall provide three (3’) feet of service loop measured from conduit fitting to end of cable for all 12”X12”X6” service box locations.
3. Backboards: Contractor shall route cables terminating to the Siemon tower modular jack panels to the bottom of the panel assembly and then up to their termination point.

O. CONDUIT REQUIREMENTS
1. All conduits shall be limited to 40% maximum cable fill ratio. EMT above ceiling or in non-visible areas shall be paint coded with Plum Safety Purple Paint with White every 10 feet. The Contractor shall never route EMT conduit outside a building. Conduit runs on roofs shall not be permitted. Conduits runs shall not have more than a total of 180 degrees of bends (to include off-sets and kicks) without a pull box. Contractor shall use conduit type required by code.
   a. SERVICE BOXES
      1) Reference Contract Drawings for requirements and locations. Any exposed service boxes shall have tamper proof hardware/screws installed for the cover. All exposed service boxes shall have stainless steel cover plates.
   b. BACKBONE CONDUITS
      1) Reference the electrical drawings for backbone conduit sizes and stub up locations within the Equipment Room or Telecommunications Rooms. For modernization projects this series of drawings may only identify the stub up location within the Equipment Room or Telecommunications Rooms.
2) Reference the electrical drawings for backbone conduit sizes, quantities, and routing requirements. This is the outside plant site plan for the Security Camera System conduits and the actual Sheet number may vary depending on Engineer. For modernization projects the outside plant site plan may not identify the requirements for the backbone conduits of the Security Camera System. It will be the responsibility of the Contractor to identify and install the backbone conduits for the Security Camera System as required in the electrical drawings.

3) Reference the electrical drawings for a single line drawing identifying the backbone conduit sizes and quantities for the Security Camera System.

4) Conduits two (2”) inches or larger shall have sweeps no smaller than ten (10) times the internal diameter of the conduit.

c. CAMERA CONDUIT

1) When installing the camera conduit in the ceiling, route two (2”) inch EMT conduit to each 12”X12”X6” pull box unless noted otherwise in the drawings.

2) Route one (1”) inch EMT conduit from each camera service box to the nearest 12”X12”X6” pull box that will provide a conduit pathway to the camera’s designated security camera backboard.

3) Underground conduits shall be a minimum one (1”) inch trade size unless otherwise noted in the drawings.

4) The Electrical contractor shall route the conduits runs where the camera pull boxes and service boxes are installed above an accessible ceiling space. If a camera service box and/or camera pull box is installed above a non-accessible ceiling space, a 2’X2’ access hatch shall be installed to allow access to the box.

5) The Electrical contractor shall take the most direct path possible for conduit runs to camera locations from their designated ER/TR. Coordinate with the Architect for available pathways and/or any aesthetic concerns which need to be taken into consideration when determining conduit route.

6) Conduits two (2”) inches or larger shall have sweeps no smaller than ten (10) times the internal diameter of the conduit.

d. PULL BOXES

1) Pull boxes shall never be used in lieu of a bend or sweep. Conduits shall enter and exit opposite ends of the box.

2) Outside Plant (In Ground) – Pull boxes shall be rated appropriately for the location where they are being installed (i.e., traffic rated versus non-deliberate traffic). For security purposes, do not mark the cover of the pull box indicating which type of service is routing through the box. Any splices which occur in the pull box shall be encased in an encapsulated enclosure intended for OSP use. Contractor shall submit the proposed encapsulated enclosure in the product submittals for approval prior to installation.

3) Inside Plant – Size boxes appropriately based on size and number conduits entering box. Security screws shall be used on all pull boxes installed below ceilings to secure the blank faceplate / cover plate. Use Allegheny “Tampruf” series of screws. Do not use nylon or plastic blank faceplates. Pull boxes should be installed in accessible ceiling spaces when possible. When installed in an accessible ceiling space, pull boxes shall be installed within twenty-four (24”) inches of the dropped ceiling but not exceed a maximum height of 20'-0” A.F.F. If pull boxes are installed in a hard lid ceiling the Contractor shall provide and install an access hatch directly below the pull box for accessibility. The access hatch shall be a minimum size of 24”X24” and be installed
a maximum distance of twenty-four (24") inches of the pull box.

3.4 INSPECTIONS (SPECIFICATION COMPLIANCE)

A. The Security Video Surveillance System performance may be compromised if several phases of construction are not performed per the Contract Documents. To ensure the Contractor is in compliance with the Contract Documents, UNLV Security Systems will require the Contractor to request an inspection at certain phases during construction. For site visit inspection requests made by the contractor, UNLV Security Systems requires forty-eight (48) hours prior notice.

B. A Security pre-construction meeting shall be requested by the Contractor within fourteen (14) days of the Contractor receiving a Notice to Proceed from UNLV. The critical phases requiring an inspection are:

1. UNDERGROUND CONDUITS
   a. Inspection of underground Security Conduits in trenches prior to back filling.
   b. Inspection of conduit placement at Security Camera backboards prior to cement slab being poured.

2. SECURITY CAMERA CONDUIT ROUGH-IN FOR EXTERIOR CAMERAS
   a. Inspection of service box locations being used for outdoor cameras, prior to a CMU wall being grouted or poured (for tilt-up installations).

3. BACKBOARDS
   a. Inspection of framing on walls which will have the Security Camera backboard prior to the Electrical Contractor routing conduits.
   b. Inspection of the electrical junction box positioning on the Security Camera backboard prior to the installation of gypsum board.

4. OVERHEAD CONDUIT
   a. Inspection of Security Video Surveillance conduits and boxes prior to any ceilings being installed.

3.5 VERIFICATION TEST REPORT

A. COPPER CABLE SYSTEM VERIFICATION TESTS

1. Upon completion of pulling the Cat 6 cable for each camera, the Contractor shall perform a test on each UTP four pair cable (see below for additional details). Perform a Category 5e Test on each camera’s Category 6 cable (test is down-graded due to the Cat 5e S110 punch blocks). Test each Category 6 cable for wire map, length, insertion loss, NEXT loss, ELFEXT, propagation delay and delay skew, return loss, PSNEXT loss, and PSELFEXT. Document, on a cable tester generated form, the compliance of every cable with these tests. Submit two (2) copies of the individual testing reports for each Category 6 cable installed, two (2) copies of the summary report for the cable tests performed and two (2) copies of the testing reports on CD-ROM in binders labeled by facility and sorted by camera number. One (1) copy of this report (CD-ROM, summary report and individual testing reports) shall be completed and submitted to the Architect at least thirty (30) days prior to the substantial completion date for the Project. One (1) copy of this report (CD-ROM, summary report and individual testing reports) shall be completed and submitted directly to UNLV – Security Systems at least thirty (30) days prior to the substantial completion date for the Project and at least ten (10) working days prior to a requested or scheduled Proof of Performance Testing date. Category 5e testing shall be performed using a Fluke DTX-1800 CableAnalyzer. Category 5e test reports produced using any other brand of test equipment shall be considered invalid and shall not be deemed acceptable by the Owner or the Owner’s representative. It is the sole responsibility of the low voltage cabling contractor to provide and use a factory calibrated (factory calibration report shall show calibration performed within nine months of the test report date and shall be included with the cable testing report package) Fluke DTX-1800 CableAnalyzer for Category 5e cable testing for this project.
a. Each cable test shall have the camera location (as identified in the electrical drawings), camera type (“A” for Analog Fixed, “HD” for HD Fixed, or “PTZ” for pan/tilt/zoom), and camera number identified for that given test. As an example, if a project had a PTZ camera with a number of 4 in Multipurpose Room A101, the test name would appear as “Multipurpose Room A101-PTZ4”.
b. The test will be performed on the Cat 6 cable for all camera locations, regardless if a power cable is already designated to be pulled with the UTP.
c. Contractor shall ensure NVP for the cable is correctly identified for the cable used prior to testing if the manufacturer of the cable type being tested is not provided in the “Cable Type” selection of the test setup.
d. Contractor shall perform a TIA Cat 5e Channel Link test for all cables.
e. Outlet configuration shall be T568A.

B. FIBER DISTRIBUTION SYSTEM VERIFICATION TESTS

1. MANUFACTURER’S TEST
   a. All fiber optic cable shall be factory tested on a reel basis with performance data for each cable supplied to the Contractor and to the Owner. Tests of multimode fiber optic cable shall be conducted utilizing an OTDR (Optical Time Domain Reflectometer with an integrated optical light source and optical power meter) at 850nm and 1300nm with the end-to-end attenuation in db/km recorded for each fiber. Tests of single mode fiber optic cable shall be conducted utilizing an OTDR (Optical Time Domain Reflectometer) at 1310nm and 1550nm with the end-to-end attenuation in db/km recorded for each fiber.

2. PRE-INSTALLATION TEST
   a. All fiber optic cable shall be inspected and continuity testing shall be performed on each fiber of each cable reel prior to installation to ensure no damage has occurred during shipment.

3. POST INSTALLATION AND TERMINATION TEST
   a. After completion of the installation of the fiber optic cable connecting the Equipment Room to the Telecommunications Room(s), perform and submit to the Owner the following tests. Tests of multimode fiber optic cable shall be conducted utilizing a Fluke DTX-1800 CableAnalyzer with an integrated optical light source and optical power meter, at 850nm and 1300nm with the end-to-end attenuation in db/km recorded for each fiber. Fiber optic cable test reports produced using any other brand of test equipment shall be considered invalid and shall not be deemed acceptable by the Owner or the Owner’s representative. It is the sole responsibility of the low voltage cabling contractor to provide and use a factory calibrated (factory calibration report shall show calibration performed within nine months of the test report date and shall be included with the cable testing report package) Fluke DTX-1800 CableAnalyzer for fiber optic cable testing for this project. Submit two (2) copies of the individual testing reports for each individual fiber optic cable strand installed, two (2) copies of the summary report for the cable tests performed and two (2) copies of the testing reports on CD-ROM in binders labeled by facility and sorted by Telecommunications Room number. One (1) copy of this report (CD-ROM, summary report and individual testing reports) shall be completed and submitted to the Architect at least thirty (30) days prior to the substantial completion date for the Project. One (1) copy of this report (CD-ROM, summary report and individual testing reports) shall be completed and submitted directly to UNLV – Security Systems at least thirty (30) days prior to the substantial completion date for the Project and at least ten (10) working days prior to a requested or scheduled Proof of Performance Testing date.
3.6 SYSTEM PERFORMANCE TESTING (CAMERA ELECTRICAL SYSTEM TEST)

A. The System Performance Testing will be facilitated and performed by the Contractor in the presence of the Owner (UNLV – Security Systems personnel). Coordinate this period so that free access to all areas, work lighting and electrical power is available on the site. Camera viewing area, video from each camera, PTZ control, and monitor checks will be made as part of the test. All video shall be clear of ground loop issues prior to the Contractor requesting the camera electrical test.

B. The System Performance Testing will also include camera positioning and focusing that will be performed by the Contractor in the presence of the Owner (UNLV – Security Systems personnel). The Contractor shall ensure that all the cameras are operational and that all necessary equipment is available to access each camera location.

3.7 SYSTEM DOCUMENTATION

A. The Contractor shall provide documentation as required in Section 01770. In addition, the Contractor shall also submit to UNLV Security Systems an electronic copy on CD or DVD in AutoCAD and Adobe Acrobat PDF formats of the as-built drawings.

3.8 WARRANTY

A. The Contractor shall guarantee the system components and labor required to meet the Scope of Work defined in this specification for a period of one (1) year after final acceptance by the Owner. This guarantee shall cover the replacement of all parts and labor to replace same made necessary by normal usage and wear.

END OF SECTION
SECTION 13726
CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Cable trays and accessories.

1.2 RELATED SECTIONS
A. Section 07840 - Firestopping.
B. Section 16170 - Grounding and Bonding.
C. Section 16190 - Supporting Devices.

1.3 REFERENCES
A. Section 01400 - Quality Requirements: 01420 - Reference Standards: Requirements for references and standards.
B. NFPA 70 - National Electrical Code.
C. ASTM A 123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
D. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process.
E. NEMA FG 1 - Fiberglass Cable Tray Systems.
F. NEMA VE 1 - Metallic Cable Tray Systems.

1.4 SUBMITTALS FOR REVIEW
A. Section 01330 – Submittal Procedures: Procedures for submittals.
B. Product Data: Provide data for fittings and accessories.
C. Shop Drawings: Indicate tray type, dimensions, support points, and finishes.
D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
F. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.5 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with
minimum ten years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. B-Line.

B. Mono-Systems, Inc.

C. MP-Husky.

2.2 LADDER-TYPE CABLE TRAY

A. Description: NEMA VE 1, Class 12B ladder type tray.

B. Material: Aluminum.

C. Finish: ASTM A 525, mill-galvanized before fabrication.

D. Inside Width: 18 inches.

E. Inside Depth: 4 inches.

F. Straight Section Rung Spacing: 6 inches on center.

G. Inside Radius of Fittings: 24 inches.

H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, drop-outs, and grounding straps.

2.3 MONO-TYPE CABLE TRAY

A. Description: NEMA Class 12B, center supported ventilated ladder type cable tray.

B. Material: Aluminum.

C. Construction: Tray shall be constructed of a center rectangular aluminum tube which forms a spine to which square/rectangular/triangular cross rungs are attached on 9 inch center. The cross rungs shall be bent up at their ends to a height of 3 inches to form a center supported, open sided, ladder like assembly. The tray must not have side rails. Rungs shall emanate at right angles from the bottom on the spine.
D. Fittings:
1. Splice Connectors - Selections of tray and all other fittings shall be joined by using a two bolt, 4 inch (100 mm) lone rectangular splice connector which telescopes into the spine of the tray. Splice connectors shall allow for thermal expansion/contraction of the tray system. The splice connectors shall be provided with a vertical hole to accept a 1/2 inched (12 mm) threaded rod which is used to support the tray in an overhead application.
2. Quick Tees - Horizontal and vertical, quick connect items shall be used for all 90 degree elbows, tees and crosses by clamping to the spine without the need for drilling or cutting this component.
3. Angle Connectors - Horizontal and vertical, shall be used for angles of 90 degrees to 30 degrees and fasten into the spine in the same manner as the above splice connector.
4. Tray Inserts and Tray Covers as well as all other accessories shall effect a complete rigid mechanical tray installation of compatible material and design.

E. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, drop-outs, and grounding straps.

2.4 WARNING SIGNS

A. Engraved Nameplates: 1/2-inch (13-mm) black letters on yellow laminated plastic nameplate, engraved with the following wording:
WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

PART 3 - EXECUTION

3.1 INSTALLATION

A. Section 01400 - Quality Requirements: Manufacturer's instructions.
B. Install metallic cable tray in accordance with NEMA VE 1.
C. Install mono-tray cable tray in accordance with Underwriter Certificate No. E.80034.
D. Support trays in accordance with Section 16190 and manufacturer's instructions. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 12 ft. maximum.
E. Use expansion connectors where required.
F. Provide firestopping under provisions of Section 07840 to sustain ratings when passing cable tray through fire-rated elements.

G. Ground and bond cable tray under provisions of Section 16170.
1. Provide continuity between tray components.
2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
3. Provide 2 AWG bare copper equipment grounding conductor through entire of tray; bond to each component.
4. Connections to tray may be made using mechanical or exothermic conductor.
H. Install warning signs at 50 feet (1500 mm) centers along cable tray, located to be visible.
I. Use only mono-type tray in headend rooms.

END OF SECTION
SECTION 13851
FIRE ALARM AND SMOKE DETECTION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Designing, installation, connection, and testing of whatever materials are required to achieve a complete, compatible, and fully operable “new” Fire Alarm and Detection System or the designing, installation, and testing as may be necessary for modifications to an operable “existing” Fire Alarm and Detection System in Buildings and Facilities owned and/or occupied by the University of Nevada Las Vegas.

1. Design:
   a. Provide for the installation of UL listed and FM approved equipment in all areas.
   b. Conform to NFPA 72 and applicable Factory Mutual (FM) Loss Prevention Data Sheet as may be required for the specific project.

2. Installation:
   a. Provide for all appurtenances and features such as painting, marking, testing, etc. to obtain a system complete and approved in all respects to this specification, and required or recommended by NFPA Standards and the applicable Factory Mutual (FM) Loss Prevention Data Sheet.

1.2 REFERENCES

A. The latest issues of the following publications, including revisions, amendments, annotations, and interpretations that are in force at the time of project design form a part of this specification. Where more than one publication applies, the publication affording the most stringent requirements shall be followed.

1. National Fire Protection Association (NFPA)
   a. NFPA 12 – Carbon Dioxide Systems
   b. NFPA 12A – Halon 1301 Fire Suppression Systems
   c. NFPA 13 – Sprinkler Systems
   d. NFPA 15 – Water Spray Systems
   e. NFPA 16 – Foam/Water Deluge and Spray Systems
   f. NFPA 17 – Dry Chemical Extinguishing Systems
   g. NFPA 17A – Wet Chemical Extinguishing Systems
   h. NFPA 20 – Fire Pumps
   i. NFPA 24 – Underground Water Distribution
   j. NFPA 25 – Inspection and Testing of Water Based Fire Suppression Systems
   k. NFPA 70 – National Electrical Code
   l. NFPA 72 – Installation, Maintenance and Use of Protective Signaling Systems
   m. NFPA 90A – Installation of Air Conditioning and Ventilating Systems

2. Factory Mutual Engineering Corporation (FM):
   a. FM Approval Guide.
   b. FM Loss Prevention Data Sheets.

3. International Conference of Building Officials (ICBO):


5. State of Nevada

6. Underwriter Laboratories, Inc. (UL):
   a. UL No. 38 – Manually Actuated Signaling Boxes
   b. UL No. 268 – Smoke Detectors for Fire Protective Signaling Systems
c. UL No. 268A – Smoke Detectors for Duct Applications  
d. UL No. 346 – Waterflow Indicators for Fire Protective Signaling Systems  
e. UL No. 464 – Audible Signaling Appliances  
f. UL No. 521 – Heat Detectors for Fire Protective Signaling Systems  
g. UL No. 864 – Control Units for Fire Protective Signaling Systems  
h. UL NO. 1971 – Visual Notification Appliances  
i. Fire Protection Equipment Directory (with Supplements)

7. Applicable local Codes, Standards, and Regulations adopted and enforced in the project’s location.
8. All requirements of the local Authority Having Jurisdiction (AHJ).
9. All requirements of the Insurer (Factory Mutual).
10. Applicable University of Nevada Las Vegas Technical Guidelines.

1.3 QUALITY ASSURANCE

A. Standards:

1. The installation shall include all appurtenances and features specified herein and required by the applicable Codes, Standards, and Regulations (to include all applicable Factory Mutual (FM) Loss Prevention Data Sheets and NFPA Standards), so as to obtain a system complete and approved in all respects for the specified occupancy, operation, and design.

2. The provisions of these standards, unless otherwise specified, shall be followed in total whether the stipulations listed therein are directed or recommended.

3. The terms “should” and “advisory material” used in these standards are to be considered mandatory unless existing conditions, as determined by the University of Nevada Las Vegas, prohibit the accomplishment of the stipulation.

4. Installed system shall in no part thereof interfere with doors, windows, heating, plumbing, or electrical equipment.

5. In cases where conflicting requirements are exhibited, the most stringent of the applicable requirements shall apply unless otherwise specifically allowed or altered by the University of Nevada Las Vegas in writing.

1.4 REGULATORY REQUIREMENTS

A. As the building/facility may be located in a jurisdiction other than the University of Nevada Las Vegas, the requirements and interpretations of the applicable Codes, Standards, and Regulations of the jurisdiction as determined by the governing authorities at the project’s location will further apply to the project.

B. The applicable Fire Insurance Carrier for all the University of Nevada Las Vegas Projects is Factory Mutual. As such, Factory Mutual shall be part of the required design submittal, review, approval, and final acceptance process.

C. Authority Having Jurisdiction:

1. For interpretation of all required Codes, Standards, and regulations, “Authorities Having Jurisdiction” shall include the applicable code defined Building Officials and Fire Chiefs where the building/facility is located, Factory Mutual (FM), and the University of Nevada Las Vegas.
   a. The University of Nevada Las Vegas reserves and retains the right as the “Final Authority” as to the manner and means the project is to proceed.
   b. As such, the University of Nevada Las Vegas shall receive copies of all applicable transmittals, responses, corrections, and applicable approvals from the other “Authorities.”
   c. Required documentation shall be submitted by, received by, and provided to the University of Nevada Las Vegas by the Fire Alarm Contractor.
   d. The University of Nevada Las Vegas shall review all design submittals including other applicable received project documentation and when satisfied the design
and equipment are in compliance with all applicable requirements, the University of Nevada Las Vegas shall accept the fire alarm system submittals before any installation work is started.

e. Only after acceptance and the notice to proceed from the University of Nevada Las Vegas is received, shall installation proceed.

1.5 QUALIFICATION REQUIREMENTS OF FIRE ALARM SYSTEM CONTRACTOR/ INSTALLER

A. State of Nevada Licensed Contractor specifically licensed and regularly engaged in the design, installation, and testing of Fire Detection and Alarm Systems. The license shall be appropriate to the work which will be performed.

B. Have supervisory personnel with demonstrated experience of at least 18 months’ experience with installing and/or maintaining Fire Alarm Systems.

C. Retention of experienced workmen who have been regularly engaged in the installation of comparable systems.

D. Accreditation or certification by the manufacturers of the equipment and devices regarding the capability and experience in proper installation of the manufacturer’s equipment or devices.

E. The University of Nevada Las Vegas may reject any proposed Fire Alarm Contractor who cannot show evidence of such qualifications. The University of Nevada Las Vegas acceptance will not relieve the Fire Alarm Contractor from his responsibilities to perform all work in accordance with specifications and contract terms.

1.6 DESIGN SUBMITTALS REQUIRED

A. Before starting installation of any materials or equipment, submit the following items to the University of Nevada Las Vegas for review and approval:

1. Copies Required:
   a. Refer to the University of Nevada Las Vegas Division 1 Specifications or specific instructions from the University of Nevada Las Vegas for the number of copies required, submittal time schedule, and the applicable procedures pertaining to processing of contractor’s submittals.

2. Qualifications of Fire Alarm System Contractor/Installer:
   a. Provide copy of license and synopsis resume of licensed personnel and supervisory personnel assigned to this project installation.

3. Complete lists of materials and equipment to be incorporated in the Work. Provide accompanying manufacturer’s descriptive data.

4. All shop drawings and designs pertaining to the installation, layout, designation of materials, fabrication of equipment, panel mounting details, conduit (locations of runs, size, supports), wiring (number of conductors, type, gauge), graphic annunciator, battery calculations, location and type of devices, Notification Appliance Circuit (NAC) load calculations, and other information fully describing the proposed fire alarm system.

5. For design re-submittals, the Fire Alarm Contractor shall also transmit all generated and received correspondence, review comments, and resolutions as part of the submittal to the University of Nevada Las Vegas for permanent retention.

1.7 APPROVAL OF MATERIALS, EQUIPMENT, AND DESIGN

A. All items proposed shall be supported by sufficient descriptive material, such as catalogs, manufacturer’s descriptive specification sheets, photographs, diagrams and other data published by the manufacturer, as well as evidence of compliance with safety and performance standards, to demonstrate conformance to the specification requirements, catalog numbers alone are not acceptable.
B. Submit information pertaining to all items that function as part of an integrated system. All such items shall be furnished at one time. In all cases, assure each submittal is appropriately marked referencing the contract drawing and/or specification section. Only after all design review comments and questions are satisfactorily resolved and applicable “approvals” are received by the AHJs will the University of Nevada Las Vegas release the Fire Alarm Contractor to commence installation.

1.8 REPAIR OF EXISTING WORK

A. Any significant damage to the building as determined by the University of Nevada Las Vegas caused by this work shall be repaired and refinished by skilled mechanics of the trade involved at no cost to the University of Nevada Las Vegas, and/or the owners.

1.9 WARRANTIES AND GUARANTEES

A. Unless otherwise specifically provided for in the construction subcontract, criteria, or specifications, the Fire Alarm Contractor, notwithstanding any final inspection, acceptance or payment, guarantees that work performed, materials, and equipment furnished under this project are in accordance with the contract requirements. The Fire Alarm Contractor also guarantees that, when installed, all materials and equipment were free from defects and will remain so for a period of at least 1 year from the date of acceptance of the entire work or part thereof, by the University of Nevada Las Vegas, or the owners. Should the fire alarm system become impaired in any way or fail, the Fire Alarm Contractor shall be responsible to correct, repair, or replace all such equipment as necessary to maintain the fire alarm system in full operating service during this guarantee period.

B. If defects of any kind should develop during the period said guarantees are in force, the University of Nevada Las Vegas shall immediately notify the Fire Alarm Contractor in writing of such defect. The University of Nevada Las Vegas thereupon shall have the rights, by a written notice to that effect, to require the Fire Alarm Contractor to repair or replace all inferior or defective work, material, or equipment or permit it to remain in place and assess the Fire Alarm Contractor the costs that would have incurred if it had been required to effect repair or replacement.

C. Fire Alarm Contractor guarantees to reimburse the University of Nevada Las Vegas or the owners for, or to repair or replace, any damaged to the site, building, or contents thereof that is caused by inferior or defective materials or equipment in the performance of this contract. The University of Nevada Las Vegas shall immediately notify the Fire Alarm Contractor in writing when such damage occurs.

D. The University of Nevada Las Vegas shall have the right to require the Fire Alarm Contractor to repair or replace such damaged areas or equipment, or elect to permit such damage to remain as is and assess the Fire Alarm Contractor the costs that would have incurred had the Fire Alarm Contractor been required to effect repair or replacement.

E. Should the Fire Alarm Contractor fail to proceed promptly, after notification by the University of Nevada Las Vegas to repair or replace any inferior or defective work, material, or equipment, or damage to the site, buildings, or contents thereof, caused by inferior or defective work, or the use of inferior or defective materials or equipment or damage, the University of Nevada Las Vegas may have these conditions repaired or replaced and charge all applicable costs incidental to the condition to the Fire Alarm Contractor.

F. Any special guarantees that may be required under the contract shall be subject to the elections set forth above, unless otherwise provided in such special guarantees.

G. In addition to the one year general guarantee covering the entire contract (General Terms and Conditions), the Fire Alarm Contractor shall furnish to the University of Nevada Las Vegas
and/or the owners, a written guarantee that any outside and/or buried cables are guaranteed to be watertight and free from defects of materials and workmanship for a period of two (2) years from the date of acceptance of the alarm system. Contractor shall correct such defects without cost to the University of Nevada Las Vegas or the owners during the life of the guarantee.

1.10 AS-BUILT SUBMITTALS REQUIRED

A. After system installation, testing, and final documented acceptance, the Fire Alarm Contractor shall submit the following items to the University of Nevada Las Vegas within 30 days of the day of Final Acceptance for permanent retention:

B. Operations and Maintenance Manuals:
1. Provide three (3) copies in 8-1/2 inch x 11 inch size, bound sets, tabbed sections with table of contents. Include the following items:
   b. Manufacturer's Descriptive Data.
   c. Copies of Approved System Acceptance and Inspection Checklists.
   d. Spare Parts Lists of Major System Components and Panels.
   e. All technical information, troubleshooting manuals, design manuals, etc. which fully describes the fire alarm system.
   f. Print out of the “Final,” as-installed, software programming.
   g. Operating Instructions:
      1) Operating instructions shall be provided for the fire alarm and remote transmission facilities. Post one set adjacent to the main alarm panel. Submit the remaining two sets of the system to the University of Nevada Las Vegas.
   h. All written warranties and guarantees which the manufacturers have supplied with their respective equipment.
   i. The Fire Alarm Contractor's written warranty and guarantee.

C. Five complete sets of Contractor produced, reviewed, and “verified” as-built drawings for all approved Drawings, control diagrams, or other graphical representation of the installed system as a whole used in the project. Drawings shall include locations of conduit runs, size, number of wires, gauge and type, wiring diagrams (reflecting wiring, component identification numbers, and point-to-point terminations), control panel details, building details, and all other such information which fully describes the “as-built” installation and condition of the “complete” Fire Alarm System.

D. One complete set of Contractor reviewed and “verified” as-built reproducible prints of all approved Drawings used in the project as referenced in “C” directly above.

E. Provide and install typewritten instruction card mounted behind a clear lexan plastic or glass cover in a stainless steel or aluminum frame.
1. Install the frame in a location directly observable from the FACP.
2. Include interpretation and appropriate response for displays and signals.
3. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

F. Provide reduced set behind plastic in Fire Control Room.

1.11 COORDINATION OF WORK

A. As part of the Work to be performed which requires actions by other subcontractors, Fire Alarm Contractor prior to starting any work under this Contract, shall coordinate all of his work operations with the University of Nevada Las Vegas Construction Representative, Contractor, the sprinkler Subcontractor, and the electrical Subcontractor as applicable.
B. Contractor shall do all cutting, fitting, and patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other subcontractors shown upon, or reasonably implied by the Drawings and specifications for the complete structure, and he shall make good after them as the University of Nevada Las Vegas may direct.

C. Performing Work in Safe Manner:
   1. Fire Alarm Contractor shall not endanger any work by cutting, excavating, or otherwise altering the work and shall not cut or alter the work of any other subcontractor except with the consent of the University of Nevada Las Vegas.

1.12 SPARE PARTS

A. General:
   1. Furnish extra materials, matching products installed, packaging with protective covering for storage, and identified with labels clearly describing contents.

B. Lamps for Remote Indicating Lamp Units:
   1. Furnish quantity equal to 10 percent of the number of units installed, but not less than 1.

C. Lamps for Strobe Units:
   1. Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.

D. Smoke Detectors, Heat Detectors:
   1. Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.

E. Detector Bases:
   1. Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new and current products of the respective manufacturers. Where two or more pieces of equipment performing the same function are required, they shall be exact duplicates produced by one manufacturer.

B. All materials and equipment shall be “APPROVED FOR THE INTENDED PURPOSE in conformity with current requirements of the applicable referenced FM and NFPA Standards.

C. If UL listed or FM approved equipment is commercially available, none other will be APPROVED.

D. Fire Alarm Contractor shall submit proof that the items furnished under this specification conform to such requirements.

E. Underwriters’ Laboratories, Inc. or Factory Mutual label or seal, or listing in the UL Equipment List and/or FM Approval Guide will not be acceptable as sufficient evidence that the items conform to the requirements of such standards.

2.2 NEW FIRE ALARM SYSTEMS

A. Supervised Fire Alarm System:
1. Provide a “new,” complete, technically current, non-coded, addressable type, microprocessor based, supervised fire alarm system independent from other circuits and including an adequate number of input, output, control, operating, and occupant warning devices so that the fire alarm system performs all necessary/required control and annunciation functions and fire alarms can be both heard and seen throughout all parts of the buildings and exterior working areas.

2. All fire alarm and fire alarm related equipment and circuits shall be specifically UL listed and FM approved for their intended purpose.

B. In general terms, the fire alarm system shall include the following equipment:

1. Main Fire Alarm Control Panel (FACP):
   a. Provide a “new” fire alarm panel capable of receiving and processing all applicable/required alarm conditions, controlling connected equipment, and transmitting alarms that are separate and distinct from all other signals such supervision or trouble to serve the building as a whole.
   b. Install main fire alarm panel in the building’s/facility’s designated Fire Control Room (FCR) or in another the University of Nevada Las Vegas “Approved” location.

2. Remote Fire Alarm Annunciator Panel:
   a. Provide and install a compatible Remote Fire Alarm Annunciator Panel connected to and as part of this new fire alarm system.

3. Emergency Power Supply:
   a. Provide an emergency power supply serving the fire alarm system which consists of batteries and an automatic charger.
   b. In case of power failure, the batteries shall be capable of maintaining the entire system in service for an approved time period.
   c. This project has an emergency generator. The fire alarm system shall also be connected to this source of electrical power.

4. Fire Alarm Signal Line Circuits (SLC):
   a. Provide and install required Signal Line Circuits (SLC) of the type and operational parameter specified for connection and interface of both fire alarm system input and output devices.

5. Fire Alarm Notification Appliance Circuits (NAC):
   a. Provide and install required Notification Appliance Circuits (NAC) of the type and operational parameter specified for connection and interface of required audible and visual occupant fire alarm warning devices.

6. Fire Alarm System Input and Output Devices:
   a. Provide and install intelligent type, fire alarm system input and output devices which are specifically compatible with the project’s fire alarm panel.
   b. Specific type, location, required control functions, required functions, etc. shall be based on the project’s specific requirements.

7. Alarm Transmission Provisions:
   a. Provide a minimum of 2 circuit closures which can be used to connect the fire alarm system to a recognized Central Station for automatic Fire Alarm notification via telephone lines leased by the University of Nevada Las Vegas.

2.3 GENERAL OPERATING REQUIREMENTS

A. Except as may be specifically shown on the approved project Drawings or criteria, each alarm initiating device and/or circuit shall be wired to produce three conditions. Monitoring of these three conditions shall also be available to the University of Nevada Las Vegas facilities department through the existing BAS.

B. Normal Condition:
   1. All devices are normally open in a non-alarm condition.
   2. Fire Alarm Control Panel interrogates each device as to its status and each device responds normal.
C. Alarm Condition:
1. Closure or initiation of any fire alarm initiating device shall cause the transmission of an “alarm” message to the FACP through the SLC.
2. FACP processes this alarm message and initiates system response and control processes based on its software programming.

D. Trouble Condition:
1. Breaking of a wire, removal of connected devices, etc. shall cause an open circuit resulting in a trouble signal in the appropriate circuit and shall sound a local signal at the alarm panel.

E. All respective initiating and/or control circuits shall remain in alarm until the device is restored to normal, and a reset switch is manually actuated at the main fire alarm panel, except that audible alarms may be silenced at the panel. General trouble indications may be self-restoring if acceptable to the University of Nevada Las Vegas.

2.4 DESIGN, MATERIALS, AND EQUIPMENT

A. General:
1. All Fire Alarm Equipment shall be specifically Underwriter’s Laboratories (UL) and/or approved by Factory Mutual for use in NFPA 72 applications.

B. Manufacturers:
1. Subject to compliance requirements, provide products by one of the following:
   a. Cerberus Pyrotronics
   b. Fire Control Instruments (FCI)
   c. Edwards
   d. Simplex Time Recorder
   e. Notifier

2.5 MAIN FIRE ALARM CONTROL PANEL (FACP)

A. FACP shall be a microprocessor based, modular component type fire alarm system having a Central Processing Unit (CPU) to monitor and control the required functions of the system.
1. CPU shall communicate with and control all of the connected equipment and devices used to make up the fire alarm system.
2. As such, all connected circuits, modules, devices, and other fire alarm equipment shall be by the same manufacturer as the fire alarm panel and be directly compatible with and addressable from the FACP.
3. FACP shall be modular and of dead front construction using solid state components to operate the system.
4. Alarm initiating and indicating circuits shall meet the requirements of NFPA 70 and 72 for Power Limited applications.

B. FACP shall include a full feature operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status Light Emitting Diodes (LEDs), and an alphanumeric key pad for the field programming and control of the fire alarm system. Operator control switches shall include, but are not limited to the following functions: acknowledge, Alarm Silence, Alarm Activate (Drill), Trouble Silence, System Reset, and Lamp Test.
1. Software programming for this system shall be EPROM based stored in non-volatile memory.
2. Proposed system shall allow the programming of any input device or function to any one (singular) or grouped (multiple) output device or function.
3. All programming or editing of the programming in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm system.
4. System shall be fully programmable, configurable, and expandable in the field without the need for special tools, PROM programmers, or require the replacement of memory circuits to facilitate programming changes.

C. Software programming and control of the system shall be protected against unauthorized access by multi-level access password or other approved method.

D. Microprocessor shall provide a real-time clock for both time and date annotations of system, displays, printer, and history purposes.
   1. Time/date function shall not be lost even if both the system’s primary and secondary power supplies fail.
   2. FACP shall contain and execute all required control functions including both control-by-time and control-by-event sequences for specific actions to be taken by the FACP if an alarm condition is detected by the system.
   3. System’s software programming shall be contained within non-volatile programmable memory and shall not be lost even if a failure in both primary and secondary power occurs.

E. FACP shall provide the following minimum features:
   1. Continuous interrogate and response supervision
   2. Drift Compensation
   3. Detector Sensitivity Test (meeting NFPA 72, Chapter 7)
   4. Multiple smoke detector sensitivity levels
   5. Ability to display or print system reports
   6. Maintenance Alerts (warning of excessive smoke detector dirt or duct accumulation)
   7. Alarm Verification Feature per device (with counters and trouble indication)
   8. Positive Alarm Sequence (PAS) presignal, meeting NFPA 72, 3-8.3
   9. Support of Non-alarm points for general (non-fire) control
   10. Automatic detector and device tests and checks
   11. Cross Zoning of both input and output circuits
   12. Walk test feature
   13. Automatic Checking for two devices with the same address
   14. Control by Time and Control by Event sequences
   15. Automatic Detector sensitivity adjustment capability for both Day and Night settings
   16. System Printer:
      a. Printer shall be an HP Laser Jet printer or equal, listed and labeled as an integral part of the fire alarm system
   17. Two (2) EIA-232 interfaces for connections to UL listed Electronic Data Processing (EDP) peripherals.

F. For desired system flexibility and to ensure program validity, a Windows based program utility shall be available by FACP’s manufacturer.
   1. This program shall be able to modify and verify the system’s programming while off-line and shall further have a verification utility.
   2. Verification utility shall scan the program files and identify possible errors.
   3. This utility shall further compare the old system software program files against new programming to specifically identify differences in the two files to allow complete testing of the system operating changes.
   4. This system verification utility shall fully meet the requirements for “testing after system modification” as required in NFPA 72.

2.6 GRAPHIC ANNUNCIATOR

A. Annunciator Panel:
   1. Indicate the building floor plan with a “You Are Here” designation.
   2. Provide an LED-indicating light located on the floor plan in each zone.
   3. Mark zone boundaries on the annunciator floor plan.
4. Provide lights that indicate the floor on which a signal was actuated if this differs from the zone.
5. Engrave zone and floor designations on the face of the annunciator.

B. Indicating lights include individual LED indicators for each type of alarm and supervisory device and an LED to indicate Trouble.
1. Actuation of any alarm or supervisory signals causes the illumination of a zone light, floor light, and device light.
2. System trouble causes the illumination of all of these lights and also the trouble light.
3. Additional LEDs indicate normal power and emergency power modes for the system.
4. A toggle or push button switch tests the LEDs mounted on the panel.
5. Test switch does not require key operation.

C. Face Plate:
1. Satin-finished stainless steel or brushed aluminum.
2. Floor plan and zone boundary lines
   a. Engraved in the faceplate and filled with colored paint.
      1) Floor plan lines:
         a) 1/4-inch (6 mm) wide black.
      2) Zone boundaries:
         a) 1/8-inch (3 mm) wide red.
3. Engraved legends for the LEDs and switches:
   a. 1/4-inch (6 mm) high minimum, letters filled with red paint.

2.7 FIRE ALARM CABINETS

A. All fire alarm system cabinets:
1. Lockable steel enclosures.
2. Panels:
   a. Arranged so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure.
3. If more than a single unit is required to form a complete control panel, provide exactly matching module unit enclosure.

B. Accommodate all components and allow ample gutter space for interconnection of panels as well as field wiring.

C. Identify each enclosure by an engraved, red-laminated, phenolic resin nameplate. Lettering on the enclosure nameplate shall not be less than 1-inch (25 mm) high, identify individual components and modules within the cabinets with permanent labels.

2.8 INDICATING ANNUNCIATORS

A. Provide individual Light Emitting Diode (LED) devices for each zone on both the FACP and Graphic Annunciator Panel.

B. An LED test switch for each FACP section illuminates all LED devices on that section of the control panel.
1. Manual toggle switches or push test-buttons do not require a key to operate.
2. Alarm and supervisory signal light a red LED on the associated zone.
3. Trouble signals light an amber LED for the associated zone.

2.9 SYSTEM INPUT CIRCUITS AND DEVICES

A. To power, communicate with fire alarm system input and output devices, and control required functions which comprise the fire alarm system, FACP shall be provided with an adequate number of Signal Line Circuits (SLC), Initiation Device Circuits (IDC), and Notification Appliance
Circuits (NAC). These circuits shall originate from either the FACP or a connected transponder (if needed depending on size).

B. For all fire alarm systems covered under this specification, the following requirements of these circuits shall apply:
1. Each SLC used for alarm, trouble, and supervisory signals from all intelligent type input and output devices shall be connected to NFPA 72 defined Style 7 (Class A) Signaling Line Circuits (SLC).
2. Initiation Device Circuits (IDC) shall be wired as NFPA 72 Style D (Class A) circuits as part of an addressable device connected by the SLC.
3. Notification Appliance Circuits (NAC) shall be wired as NFPA 72 Style Z (Class A) circuits as part of an addressable device connected by the SLC Circuit(s).
4. A single ground fault or open circuit on any SLC shall not cause system malfunction, loss of operating power, or the ability to report an alarm condition.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

2.10 SYSTEM INPUT DEVICES

A. Required Fire alarm input devices shall specifically be Listed/Approved compatible with the proposed FACP and shall include, but are not limited to, the following:
1. Manual Fire Alarm Pull Stations:
   a. Provide and install flush mounted, addressable type, double action type Manual Fire Alarm Pull Stations finished in red with raised letter operating instructions of contrasting color. Stations shall be located in all interior locations on the latch side of each building exit and others locations as required. Boxes shall be mounted with the bottom at least 3-1/2 feet but not more than 5 feet above the floor level and shall be so located where they are “accessible” as defined in the ADA. Stations shall latch in the activate position and shall require the use of a key or special wrench to reset. The use of manual fire alarm pull stations which use break-glass rods or similar devices requiring replacement shall not be acceptable.
2. Sprinkler System Waterflow Switch:
   a. Provide and install addressable monitor modules and interface to normally open contacts of each waterflow device. Input to the addressable module shall be wired as either a supervised four wire NFPA 72 Style D (Class A) or a two wire NFPA 72 Style B (Class B) Initiation Device Circuit (IDC) circuit. An LED on the addressable monitor module shall be provided that flashes under normal conditions indicating that the module is operational and is in communication with the FACP.
3. Area Smoke Detectors:
   a. As required for the specific occupancy, use, and purpose, provide and install Ionization, Photoelectric, or project beam type addressable smoke detectors in applicable areas. Smoke Detectors shall be specifically UL listed/FM approved “Compatible” with the intended FACP. Each detector shall have associated address switches, etc. located on the detector itself (not on its corresponding base). Required locations, spacing, environmental, and operational considerations, potential for smoke stratification, and other limitations shall be as referenced in the NFPA Standards or as may be applicable in the device’s specific listing or approval. All smoke detectors shall exhibit the following minimums:
   b. Factory nameplate:
   c. Serial number and type identification.
   d. Operating Voltage:
      1) 24 VDC, nominal.
   e. Self-Restoring:
      1) Detectors do not require resetting or re-adjustment after actuation to
restore them to normal operation.

f. Plug-In Arrangement:
   1) Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs to secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.

g. Visual Indicator:
   1) Flashes to indicate functioning, connected to indicate detector has operated.

h. Addressability:
   1) Detectors include a communication transmitter and receiver having a unique identification and capability for status reporting to the FACP.

i. Remote Controllability:
   1) Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.

4. Duct Detectors:
   a. Provide and install Ionization or Photoelectric type smoke detectors within all HVAC units rated 2,000 CFM and greater for remote indication, shutdown, and reset of a detected smoke condition. Smoke Detectors shall be specifically UL listed/FM approved “Compatible” with the intended fire alarm panel, shall be operable under all operating conditions (temperature, air velocity, etc.), and shall be only located in “interior” areas of the building/facility. Installation of detectors in exterior locations shall not be acceptable unless smoke detector along with its applicable assembly is specifically Listed/approved for high temperature applications. In areas where smoke detectors are not easily accessible, provide and install a key operated remote test switch (normal-reset-test). Duct mounted smoke detector shall have air sampling tubes for the specific duct size and installation conditions where applied. Fan shutdown may be through the use of either an “addressable” type relay which is an integral part of the smoke detector or by a separate addressable control relay connected to the SLC.

5. Heat Detectors:
   a. Provide and install addressable type, combination Fixed Temperature/Rate-of-Rise restorable type heat detectors. Each such heat detector shall have a fixed temperature rating of 135 degrees F (58 degrees C) and have a rate-or-rise element rated at 15 degrees F (9.4 degrees C) per minute. Each unit shall be connected to the SLC with its required addressable switches located in/on each unit. Heat detectors shall fit in the same twist-in base and have alarm indication lamps as the compatible smoke detectors connected to the system. Systems heat detectors shall have communications transmitter and receiver with unique identification and capability for status-reporting to the FACP. If higher temperature rated heat Detectors are required, individual, normally open contact type heat detectors connected via IDC to an addressable monitor module connected to FACP will be required.

6. UV, IR, or Combination UV/IR Flame and Fire Detectors.

7. Post Indicator Valve:
   a. All valves controlling the water supply to the fire suppression system(s) shall have their valves electrically positioned, supervised, and monitored by the FACP. These valves shall be connected to cause an audible signal and visual supervisory alarm at the main fire alarm panel before the valve stem is moved more than one and one half turns from the normally open position.

8. Tamper Alarm Switches:
   a. Tamper alarm switches shall be provided to actuate an audible signal and supervisory alarm if the cover to the valve position supervisory switch is removed in an attempt to bypass the valve position switch.
B. Electrical Connections Description:
1. Provide and install required modules and electrical connections to all:
   a. All new and/or existing sprinkler system water flow switches provided by the sprinkler contractor.
   b. All new and/or existing Valve Position Supervisory and Tamper Switches on all valve controlling the fire protection water supply provided by the sprinkler contractor.
   c. All new and/or existing fire protection and fire protection related equipment, devices, and systems including, but not limited to, fire alarm sub-systems, Special Fire protection sub-systems (dry chemical, carbon dioxide, etc.) emergency generator, electric and diesel fire pumps, jockey fire pumps, tank level monitors, air pressure supervisory switches, and other such related equipment.
2. Required Operation:
   a. Operation of any “fire alarm” initiating device shall sound a continuous audible fire alarm throughout the building and/or area, visually annunciates on all strobes attached to fire alarm audible devices throughout the building, perform all required functions (release doors, elevator recall, automatic shut down of systems/equipment, automatic unlocking of any locked means of egress, etc.), and transmit a fire alarm to the central station until the alarm initiating device has been restored to normal, and a reset switch manually actuated at the control panel, except that audible alarms may be silenced at the control panel.
   b. Operation of any alarm initiating device shall be specifically identified on the FACP’s LCD display and shall further light its associated alarm annunciator Light Emitting Diode (LED).

C. Actuation of initiating device places circuit in alarm mode, which causes the following system operations:
1. Sound and display local fire alarm signaling devices with required tone.
2. Transmit signal to central station.
3. Indicate location of alarm zone on fire alarm control panel and remote panel.
4. Transmit signals to Building’s Smoke Control System (as applicable).
5. Transmit signals to elevator control panel to initiate return to main floor or alternate floor.
6. Transmit signal to building mechanical systems to initiate shutdown of fans and damper operation.
7. Transmit a signal to release door hold-open devices (by zone, area, or common).

2.11 SYSTEM ALARM OUTPUT DEVICES

A. Required output circuits that provide control over other systems and circuits as part of the fire alarm system shall be provided through the use of addressable monitor and control modules connected to the FACP by an appropriate SLC.

B. For all fire alarm systems covered under this specification, Addressable Control Relays, Monitor Modules, and other “addressable” equipment will be required to provide life safety control functions to other equipment and systems such as:
1. Fire Door Control
2. Elevator Recall
3. HVAC and Fire Damper Control
4. Exhaust Fan Control
5. Initiation of Smoke Removal Systems
6. Initiation and monitoring of Smoke Management Systems

C. Addressable Interface Units:
1. Arrange to monitor one or more system components that are not otherwise equipped for multiplex communications.
2. Units transmit identification and status to the FACP using communication transmitter and receiver with unique identification and capability for status reporting to the FACP.

2.12 AUDIBLE AND VISUAL ALARM NOTIFICATION DEVICES

A. Furnish and install Listed/Approved Notification Appliance Modules and circuits to provide required occupant audible and visual warning of a fire condition in accordance with the following requirements:

1. All NAC Circuits:
   a. Supervised NFPA 72 Style Z (Class A) circuits.

2. Connection loads:
   a. Dependent on the required total current of all of the connected devices, the IR drop of the circuit, and the manufacturer’s required safety margin.

3. Provide and install Fire Alarm Audible Occupant Notification Appliances throughout the building/facility so that the fire alarm signal can be heard in all areas of the building. Sound pressure levels shall be as required in both the applicable standards and ADA requirements.

4. Provide and install Fire Alarm Visual Occupant Notification Appliances throughout the building/facility (zoned to conform with the applicable Audible appliances) so that the fire alarm signal can be seen in all areas of the building. Light intensity, frequency, and so forth shall be as required in both the applicable standards and ADA requirements.

5. Fire Alarm Horns:
   a. Electric-vibrating type polarized type operating on 24 VDC (for systems not requiring public address announcement capabilities) with provision for housing the operating mechanism behind the grille.
   b. Horns produce a sound pressure level of 90 dBA, measured 10 feet (3 meters) from the source.
   c. Horns shall produce a signal less than 900 Hz audible frequency.

6. Visual Alarm Devices:
   a. 24 VDC “RED” strobe light with RED polycarbonate lens and xenon flash tube.
   b. Word “Fire” engraved in 1-inch (25 mm) high letters on the lens.
   c. Lamps shall have a minimum peak intensity meeting the requirements of both ANSI A177 and ADA.
   d. Strobe leads: From factory-connected screw terminals.
   e. Combination devices consisting of factory-combined audible and visual alarm units in a single mounting assembly.
   f. Location, spacing, frequency, and so forth complying with ADA.
   g. In large areas, flashes caused from the strobe appliances shall be synchronized.

2.13 TROUBLE SIGNAL ANNUNCIATION AND CONTROL

A. When trouble signals are silenced after being sounded by faults on either the alarm initiating circuit or the alarm signaling circuit, the trouble signal circuit shall restore to normal automatically without manual restoration of associated trouble signaling silencing switch. Audible trouble signal and associated visual indication shall reactivate upon a new trouble detected elsewhere in the system.

B. Provide a separate LED to light in the event trouble signal is caused by a fault on the alarm signal circuit. Relays used for sounding alarm bells or trouble signals shall have their coils electrically supervised and sound a trouble signal in the event of an open coil.

2.14 FIRE ALARM ZONES

A. Designed fire alarm system zones provided to each project shall follow the same geographic separations used for the automatic sprinkler.
B. Dependent upon size, the FACP may be required to have significant input/output capability.

C. Fire alarm panel shall provide immediate indication of the particular zone involved upon actuation of any fire detection, fire suppression system, or supervisory system within that area.

2.15 CONDUIT AND WIRE

A. Use of Conduit
1. In all locations, install all of fire alarm system’s circuits in appropriately sized UL listed conduit, raceways, and other electrical enclosures in accordance with NFPA 70 (National Electrical Code) in addition to local and state electrical codes, standards, and regulations.
2. Where required, conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

B. All cabling used for the fire alarm system shall be separated from all open conductors of power, or Class I circuits, and shall not be placed within any conduit, junction box, or raceway containing these conductors or circuits in accordance with NEC Article 760-29.
1. Wiring for 24 volt DC control, alarm notification, emergency communications, and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits.
2. Provide all circuits with transient suppression devices and design the system to permit simultaneous operation of all circuits without interference or loss of signal.

C. Conduit shall not enter the FACP, or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified and provided for by the FACP manufacturer.

2.16 WIRING

A. All wiring and circuits shall conform to the latest edition of NFPA 70 and shall be UL listed and FM approved for their intended purpose. Wiring shall be covered by approved thermoplastic insulation.

B. All conductors used for either Signal Loop Circuits (SLC), Initiation Device Circuits (IDC), and Notification Appliance Circuits (NAC) shall be solid copper, Power Limited Fire-Protective Signaling Cable. Number and size of conductors shall be as recommended or required by the manufacturer but not less than 18 AWG (1.02 mm) for Initiating Device Circuits (IDC) and Signaling Line Circuits (SLC), and 12 AWG (1.63 mm) for Notification Appliance Circuits (NAC).

C. All IDC, SLC, and NAC circuits shall be electrically supervised for open circuit and ground fault conditions. None of these circuits shall be allowed to have any t-tapping or t-splices unless the fire alarm equipment and circuits specifically allow for this arrangement.

D. For 120 volt AC power connection circuits, wire size shall not be less than No. 12 AWG. Actual conductor size shall be dependent on the applicable manufacture’s operational requirements and local requirements.

E. Each conductor used for the same specified circuit function shall be distinctly color-coded with solid colors, one for each loop.
1. Use a separate color and conduit for all alarm horn circuits and for all 120 VAC control circuits.
2. Exposed end of conduits shall be bushed to prevent damage to wire insulation.
3. If polarized devices are used, then two separate colors shall be used to designate positive and negative.

F. Circuits to alarm initiating devices shall be specifically UL listed for Power Limited Fire Alarm
service.
1. Size wire to accommodate any IR drops incurred with long runs.
2. Wiring that must be buried or is subject to the elements shall be weatherproofed in a manner acceptable to the University of Nevada Las Vegas.

2.17 OPERATING POWER SYSTEMS

A. Primary AC Power:
1. Base requirements for the fire alarm system on the manufacturer's power requirements.
2. Service connections for the system shall be ahead of all cutouts and breakers in the designated electrical panel.
3. Mount system circuit protections in separate lockable cabinets painted red and identify as a fire alarm panel power supply.
4. Ampere rating of circuit protection: As required by NEC and manufacturer's requirements.
5. All power supply wiring: In appropriately sized UL listed metal conduit.
6. This entire building has an emergency generator. The fire alarm system shall also be connected to it in addition to the system's dedicated battery supply.

B. Standby Battery and Charger:
1. Standby battery and charger for the fire alarm system:
   a. Designed and furnished by the manufacturer to sound alarms in the event of loss of 120 VAC.
   b. Batteries shall have sufficient capacity to sound alarms for a period of 15 minutes after a 24-hour interruption of 120 VAC.
   c. Charger:
      1) Capable of recharging the batteries fully within 14 hours.
      2) Under normal charging service, charger shall charge the battery at a higher current until battery is fully charged and then maintain battery at a constant supervisory current.
      3) Charger shall contain both a voltmeter and an ammeter of 5 percent accuracy. In the event of loss of 120 VAC, a trouble signal shall sound.

C. Upon loss of the primary VAC power supply, the system shall transfer the load to the battery supply without loss of signals, status indications, or system programming.

D. Emergency power shall supply the circuit or circuits automatically upon loss of the primary power supply source.
1. Emergency power supply shall conform to provisions of NFPA 72 and NFPA 70.
2. Use only maintenance free rechargeable type lead antimony storage batteries or "gel cells."
3. Do not use primary, dry cell, or nickel cadmium batteries.
4. In the event of power failure, a trouble signal and associated light on the alarm panels shall operate to alert personnel that power has failed.

2.18 SIGNALS AND PUBLIC ADDRESS

A. Depending on the size and type of proposed occupancy, provisions for an emergency public address voice announcement system as part of the fire alarm system may be required. As such, the following requirements shall apply:
1. Each circuit shall be supervised, so that an open or short in any circuit will result in an audible and visual trouble indication. Spare circuits shall be used for future requirements and shall be suitably terminated.
2. All alarm horn signal circuits shall be powered by continuously supervised amplifiers using computer-grade solid-state components throughout. Vacuum tubes shall not be acceptable.
3. Failure of either the primary amplifier(s) shall immediately cause an audible and visual signal.
trouble signal to sound and shall simultaneously transfer all signal circuits to back-up operational amplifier(s). All amplifiers shall be rated for continuous maximum power output. Amplifier(s) shall be appropriately sized as to power all alarm horns simultaneously and shall have at least 30 percent reserve power capacity for future use.

4. Tone generators shall produce signals less than 900 Hz audible frequency.

5. All tone generators shall be continuously supervised, multi-channel type using computer-grade solid state components throughout.

6. Failure of either the primary or secondary fire tone generator shall initiate an audible and visual trouble signal and immediately transfer to the active tone generator.

7. One primary and two primary auxiliary emergency signal generators or tone cards shall be provided to generate four distinctive sounds for each of the following signal conditions without exception:
   a. Fire Alarm (Primary Generator)
   b. Early Warning (Auxiliary No. 1)
   c. Emergency Evacuation (Auxiliary No. 2)
   d. Fire Alarm (Back-up Generator)

8. All tones shall be non-interfering and shall be assigned priorities. The fire alarm tone shall have highest priority. Auxiliary tones shall have lower priority. It shall not be possible to sound two or more tones simultaneously.

9. The generation of the above required tones shall be through the use of easily replaceable tone cards and/or modules.

10. If proposed manufacturer equipment must be modified to produce these required tones, the manufacturer shall submit proof that such “modified” equipment is UL listed and specifically listed with the proposed equipment. Acceptable proof shall be in the form of formal correspondence from the factory and is to include the UL listing card associated with the modified equipment.

11. All fire alarm system amplifiers shall be solid state, 24 VDC, continuously supervised UL listed and/or FM approved amplifiers 100 percent compatible with and manufactured by the same manufacturer of the proposed fire alarm system.

12. A hand-held dynamic microphone, located within the main fire alarm panel, shall be provided behind a locked access door. The microphone shall be provided with a build-in press-to-talk switch which shall, when operated, interrupt any alarm tone and allow voice transmission to all alarm signal horns.

13. Operation of the microphone press-to-talk switch shall permit voice communication override on all alarm signal horns. When the press-to-talk switch is released, the alarm tone shall resound on all the alarm signal horns.

14. Alarm Speaker Horns:

15. Building audible Alarm devices (audio (electronic tone/voice) and visual) shall be speaker horns with flashing lights installed on supervised circuits. Horns shall be located as indicated on Drawings. Alarm speaker horns shall be UL listed reentrant type horns housed in die-cast aluminum frames and grilles finished in high-gloss red enamel.

16. Construction shall be such as to permit safe use in boiler rooms and exterior locations without impairing the quality of tone or voice reproduction in climates ranging from -30 degrees F to 150 degrees F. The horn diaphragm shall be constructed of a polyamide phenolic material. The housing shall contain a short, rapid-flared, folded reentrant type horn, and shall reasonably protect the horn mechanism from malicious attack.

17. The alarm signal horns shall be multi-tap (0.5, 2, 6 watt) with visual indicator in all interior locations and 15 watt in all exterior locations or approved equal. The visual indicating strobe devices shall be an integral part of the speaker horn assembly. Operating voltage for both devices shall be 24 VDC without exception.

18. For design purposes, all “exterior” mounted speaker horns shall be tapped at 15 watts apiece and shall be on circuits separate from interior audible speaker horn circuits. The connection of “exterior” mounted speaker horns to “interior” speaker horn circuits or “interior” speaker horns to “exterior” speaker horn circuits is not acceptable.
2.19 MODIFICATIONS TO EXISTING FIRE ALARM SYSTEMS

A. Special Requirements:
   a. Connect new fire alarm system to existing campus wide system.

2.20 MATERIAL AND EQUIPMENT

   A. If a "pre-existing" programmable and/or addressable type requires Addressability to function, then it must be accomplished using the same manufacturer’s equipment and programming.

2.21 ANSI A117 MODIFICATIONS

   A. ANSI A117 add-on power supplies.
   B. Location of devices – ANSI A117.
   C. Interface with existing equipment.
   D. Listing/approval with existing equipment.

PART 3 - EXECUTION

3.1 SYSTEM SUPPORT

   A. On-Site capabilities:
      1. As part of any fire alarm system contract for the facility, the Fire Alarm Contractor shall provide the following:
         a. For the University of Nevada Las Vegas’ permanent retention, an inventory of spare parts necessary for proper repair of the fire alarm system as a whole.
         b. Spare parts shall (at a minimum) include at least 1 spare module for each different module used to make up the fire alarm system.
         c. Included in these spare parts shall be at least 1 complete set of EPROMS, RAM, ROM, etc., semiconductors which make up the system’s programming.
         d. The University of Nevada Las Vegas will advise the Fire Alarm Contractor as to the required amount of spare parts necessary.
         e. All technical information, trouble-shooting manuals, design manuals, full sets of internal schematics, and other information which fully describe the fire alarm system (refer to Part 1 for submittals requirements).
         f. Specific information and equipment to change the system’s programming without any additional support from the manufacturer nor the local representative.
         g. A minimum of 8 hours of intense training conducted by a qualified, factory authorized, fire alarm technician fully versed in the theory of operation and programming of the proposed system, as a whole.
         h. For permanent retention, any and all unique test equipment associated with the testing, maintenance, trouble-shooting, and repair of this system as a whole.

   B. Factory Support:
      a. Proposed manufacturer shall show evidence and agree to (in the form of formal correspondence) provide product support (both physically and technically) to this type, style, operation, and so forth of proposed equipment for a period of not less than 10 years from the date of initial award of Contract.

3.2 WORKMANSHIP

   A. Electrical work shall conform to NFPA 70 and this specification.
B. Lay out the work carefully in advance.

C. Where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces in necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, do this work carefully.

D. Cutting, channeling, chasing, and drilling shall be done in a neat and workmanlike manner.

E. Installation shall not damage the building or wall or ceiling finishes, and the shall be compatible with adjacent University of Nevada Las Vegas facilities and University of Nevada Las Vegas electrical installation standards.

F. Wiring shall be inconspicuous, concealed where practicable in finished areas and exposed otherwise, and shall be in accordance with the applicable provisions of NFPA 70, National Electrical Code, Article 760.

3.3 INSPECTION, TESTING, AND ACCEPTANCE

A. After each segment of the Work has been fully installed, the Fire Alarm Contractor shall perform the following inspection and test Work on each segment according to a schedule mutually agreed upon, as a condition precedent to final acceptance of the Work.

1. Contractor’s Inspections:
   a. Performed by Fire Alarm Contractor at his convenience to satisfy himself that the system or segment is in complete operating order and meets all requirements of the project’s criteria and these specifications and to assure that the system or segment is fully ready for final inspections and acceptance test.
   b. Consist of the necessary inspections to assure that all systems or segment components have been mounted and installed in accordance with manufacturer’s instruction and shop drawings and that all electrical materials and equipment have been installed in accordance with these specifications, manufacturer’s instructions, and specifications and shop drawings.

2. Contractor’s Test:
   a. Performed by the Fire Alarm Contractor at his convenience to satisfy himself that the system or segment is in complete operating order, and meets all requirements of the University of Nevada Las Vegas furnished criteria and specifications, and to assure that the system or segment is fully ready for final testing and acceptance by the University of Nevada Las Vegas.
   b. Testing shall ensure there are no shorts or grounds in all systems and segments.

3. Fire Alarm Contractor shall make the necessary connection to power supply and preliminary operational tests to verify proper line voltage, and to verify proper operation of all functions of all system or segment components and circuits, all in accordance with manufacturers’ standard procedures and instructions and applicable portions of these specifications.

4. When the Fire Alarm Contractor has satisfied himself that each system is in complete operating condition in every respect as required above, he shall notify the University of Nevada Las Vegas Construction Representative in writing that the system or segment has been inspected and tested and is ready for final inspection/acceptance tests, giving at least five (5) working days’ notice of the desired date and time of such tests.

5. Final Inspection:
   a. Final Inspections of all phases of work shall be made by and at the discretion of the University of Nevada Las Vegas Construction Representative prior to final acceptance tests.
   b. Inspection shall include physical removal of any or all devices and/or wiring box covers to observe wiring methods or effects on systems.

B. Final Acceptance Testing:
1. Performed by Fire Alarm Contractor and witnessed by the University of Nevada Las Vegas Construction Representative, other the University of Nevada Las Vegas Divisions, and all other Authorities Having Jurisdiction where applicable.
   a. Note: As part of these tests, all smoke detectors shall be sensitivity tested in accordance with NFPA 72E and manufacturer requirements.
2. Final testing shall consist of operational testing to verify proper operation of each system or segment in every respect, including all circuits and components and electrical verification of auxiliary contact operation.
3. Testing shall also require all field circuits to be tested for proper electrical supervision by removing conductors from all alarm initiating and indicating circuits.
4. Any faults or malfunctions in system, segment, or component operation discovered shall be corrected and final inspection and testing shall be repeated as directed by the University of Nevada Las Vegas Construction Representative.
5. Successful completion of final inspection and acceptance tests, as determined by the University of Nevada Las Vegas Construction Representative shall constitute evidence of satisfactory completion of the respective system or segment.

3.4 PAINTING

A. Except where required by the University of Nevada Las Vegas, exposed conduit, hangers, and supports shall not be painted. Where painting is specified, exposed conduits, hangers, and supports shall be given one coat or primer and finished coat to match existing surfaces.

B. Factory-Painted Equipment:
   1. Factory-painted equipment shall not be repainted another color unless required by this specification. Example: power supply panel.

C. Conduit:
   1. All conduit used for the fire alarm system shall be painted red.

D. Cover Plates:
   1. All cover plates for all junction boxes, whether conduit is painted or not, shall be painted red and stenciled with the letters “FA” not less than one inch high, white block lettering.

3.5 CLEANING AND DEBRIS REMOVAL

A. Comply with Section 01740.

B. At the completion of the Work, all waste materials and rubbish from and about the project as well as all tools, construction equipment, machinery and surplus materials shall be removed and disposed of in a manner acceptable to local and state regulations.

C. All glass surfaces shall be cleaned and all areas shall be “broom-clean” or its equivalent.

3.6 INTERRUPTION OF UTILITIES

A. Any service connections to existing utilities that would interrupt services to project’s facility operations shall be done on Saturdays, Sundays, or federally recognized holidays, and shall have prior approval by the University of Nevada Las Vegas, 7 days prior notice is required.

B. Work outside regular hours: If the Fire Alarm Contractor desires to carry on work outside regular hours (0730 - 1600 hours) or on Saturday, Sunday or federal legal holidays, he shall submit application in advance to the University of Nevada Las Vegas Construction Representative, but shall allow ample time to enable satisfactory arrangements to be made.

3.7 SURPLUS
A. All the University of Nevada Las Vegas or other owned construction materials and/or equipment on the construction site, declared surplus as determined by the University of Nevada Las Vegas Construction Representative, shall be removed from the property by the subcontractors of the respective trades as directed by the University of Nevada Las Vegas Construction Representative.

3.8 COOPERATION

A. The Contractor shall instruct each of his subcontractors (if applicable) as follows:
   1. Consult with those doing work under other divisions to ascertain the locations of their various materials and to familiarize them with his own material locations, making such changes as may be required to obtain the best results in the opinion of the Field Construction Engineer, whose decision shall be final.
   2. Schedule his work and cooperate with those doing work under other divisions so as to avoid delays, interferences, and unnecessary work, conforming to the schedule of operations, making the installation when and where directed.
   3. Make all necessary changes, including removal and reinstalling of materials at his own expense, if he fails to check with those doing work under other divisions and his installed work is later found to interfere with work of other divisions.
   4. The Fire Alarm Contractor shall make a close inspection of all materials as delivered and all work in progress and shall promptly reject and return all defective materials and redo any sub-standard work without waiting for their rejection by the University of Nevada Las Vegas Field Construction Engineer.

3.9 SAFETY AND HEALTH STANDARDS

A. Comply with the local requirements and OSHA shall be required.

B. All Contractors and Subcontractors are subject to inspection of job sites by the University of Nevada Las Vegas, Building and Fire Departments, and other Safety Inspectors.

C. Resolution of Violations of Occupational Safety and Health Act Safety and health Standards are a contractors/subcontractors responsibility.

D. Use of intoxicants or the use of other than officially provided and designated facilities, or improper conduct by workmen on premises, shall be grounds for permanent removal of any employee from the project site.

E. In no way shall the Contractor, Subcontractors, or anyone else involved with this project block any exit from the building or endanger any personnel.

END OF SECTION
PART 1 - GENERAL

1.1 GENERAL CONDITIONS AND SPECIAL CONDITIONS

A. Division 1 General Requirements of these specifications shall apply to the work in this section.

B. The Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said systems being made ready for operation in accordance with the requirements of NFPA, NFC, and the authorities having jurisdiction. The purpose of the Engineer specifications and drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission by Engineer of any necessary system component as required by the authorities having jurisdiction, in the specifications and drawings shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the Owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Designer/Builder and Engineer for clarification prior to the bid due date.

C. The Contractor shall provide all devices and equipment required by these specifications and drawings. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

1.2 PERFORMANCE GUIDELINES

A. Work provided under this section
1. Site visit to determine existing conditions and extent of work.
2. Review of project drawings to determine extent of work.
3. Complete fire protection systems as outlined in these specifications, including all labor, materials and shop drawings needed to furnish and install a complete automatic sprinkler system, and all of the following:
   a. Siamese-type fire department connection with check valve and ball drip on the outside wall of the riser room or location approved by AHJ.
   b. Core drilling of floors and walls, and required firestopping. Patch as required.
   c. Wet pipe fire sprinkler systems, complete with supervised control valves, flow switch, drain piping and inspector’s test valve.
   d. Coordination of work with all other trades including coordination of sleeved holes in the main precast concrete floor beams.
   e. Shop drawings.
   f. Operating instructions and valve diagrams.
   g. As-built drawings.
   h. Waterflow and valve supervisory switches.
   i. Sleeves.
   j. Inserts.
   k. Cutting and patching.
   l. Cutting and patching required for new concealed piping installations in existing dropped ceiling areas. After completion of the work, ceilings shall match the existing ceilings in every respect. Only qualified workmen familiar with this type of work shall be employed.
1.3 SYSTEM ABBREVIATIONS AND DEFINITIONS

A Approved: Unless otherwise stated, materials, equipment or submittals approved by the Engineer.


C Architect: Tate Snyder Kimsey (TSK)


E AWS: American Welding Society.


G Concealed: Where used in connection with installation of piping or conduit and accessories, shall mean "hidden from sight" as in shafts, furred spaces, in soffits or above suspended ceilings.

H Contractor: The company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers or fabricators.

I CLVFR City of Las Vegas Fire & Rescue.

J DP: Dry pendent sprinkler.

K EC: Extended coverage sprinkler.

L ELO Extra large orifice sprinkler.

M Engineer: Schirmer Engineering Corporation (SEC).

N Exposed: Where used in connection with installation of piping or conduit and accessories, shall mean "visible" or "not concealed".

O FDC: Fire department connection.

P FM: Factory Mutual

Q FM Approved: Materials or equipment approved by Factory Mutual and included in the most recent edition of the FM Approval Guide.

R Furnish: Supply materials.

S gpm: Gallons per minute.

T Install: Install materials, mount and connect equipment or assemblies.


1.4 RELATED WORK

A Materials and methods specified in other sections:
   1. Underground piping terminating in the fire riser room.
2. Painting of sprinkler piping, hangers, and valves, including placing and removal of bags or other protection devices on sprinklers to prevent paint from touching any portion of a sprinkler.

3. Painting of finished surfaces at pipe penetrations.

4. Construction of new rated riser room as indicated on the design drawings.

5. Adequate heat for valve and riser rooms.

B. Materials furnished and installed in this section but wired by Others:

1. Valve supervisory devices shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.

2. Waterflow switches shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.

1.5 DESIGN CRITERIA

A. Sprinkler Systems:

1. Provide a wet pipe sprinkler system with quick response, upright, pendent, and extended coverage sprinklers as indicated on the fire sprinkler contractor plans for complete protection of all areas with pipe sized per hydraulic calculations.

2. All areas excluding outdoor covered walkways to be protected with wet pipe system. These are to be considered in the hydraulic calculations.

   a. Light Hazard density - 0.10 gpm per 1,500 ft² for class rooms, offices and assembly spaces.

   b. Ordinary Hazard, Group 1 density - 0.15 gpm per 1,500 ft² for kitchen and services area, mechanical room.

   c. Ordinary Hazard, Group 2 – 0.20 gpm per 1,500 ft² for storage areas, auto shop and wood shop.

3. Any changes in design area, number of sprinklers operating, pipe schedule, pipe sizes, number of branch lines, number of mains or deviation from water supply as stated on the drawings shall necessitate complete hydraulic calculations by the Contractor and approval of changes by SEC prior to fabrication of pipe.

4. Location of sprinkler head spacing shall be approved by the Architect before the start of construction.

5. Contractor shall submit calculations along with the shop drawings.

B. Area Hydraulics

1. System designed per a waterflow tested conducted within 12 months of the submitted calculations. A flow test conducted by SEC is acceptable.

1.6 APPLICABLE STANDARDS

A. Reference Standards: The following standards are included as part of this specification:

1. National Fire Protection Association (NFPA):


   b. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.


2. American National Standards Institute, Inc. (ANSI) Standards, current editions:


   b. A21.6 - Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids.

   c. A21.8 - Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds, for Water or Other Liquids.


f. A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

g. B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, 24, 125, 250, and 800 Pounds.

h. B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

i. B18.2.1 - Square and Hex Bolts and Screws.

j. B18.2.2 - Square and Hex Nuts.

k. B36.10 - Welded and Seamless Wrought Steel Pipe.


   a. A 53 - Standard for Welded and Seamless Steel Pipe.
   c. A 795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
   f. D1869 - Rubber Rings for Asbestos - Cement Pipe.

4. Factory Mutual Systems (FM) Publication:
   a. Approval Guide.

5. Underwriters Laboratories, Inc. (UL) Publication:

6. American Water Works Association (AWWA) Standards, current editions:
   a. B300-64 - Hypochlorites.
   c. C200-75 - Steel Water Pipe 6 Inches and Larger.
   e. C207-55 - Steel Pipe Flanges.
   f. C400-75 - Asbestos-Cement Pressure Pipe for Water and Other Liquids.
   g. C500-71 - Gate Valves - 3 through 48 inch - for Water and Other Liquids.


1.7 SUBMITTALS

A. Coordinate and attend a design development meeting with the Architect, precast concrete floor manufacturer, structural engineer, and Contractor to discuss precast beam sleeving locations.

B. Shop Drawings
   1. Submit ten (10) copies of complete shop drawings and manufacturers' data to the owner, SEC and FM Global for all necessary reviews prior to fabrication of materials.
   2. Contractor shall submit complete system packages. Partial system submittals will be rejected.
   3. When the plans are rejected because of incomplete or incorrect information, the Contractor shall be responsible for the Engineer's extra review time and expenses beyond one resubmittal. Such extra fees shall be paid by the Contractor directly to the engineer when the resubmittal is made. The Contractor is not responsible for the engineer's review time for the first submittal and first resubmittal, or for resubmittals required because of project changes.
   4. The Engineer will return nine (9) prints to the Contractor, who shall then submit required prints to the Architect who shall review them and return seven (7) copies to the Contractor who will then submit to the SFM and CLVFR for final review and approval.
   5. Hydraulic calculations shall include a water supply graph and hydraulic cover sheet. The cover sheet shall include the name and location of the calculated area, ceiling height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make,
model, size, K factor and temperature rating, flow requirements, C factor used, water supply data and source of information.

6. Prepare shop drawings at minimum scale of 1/8" = 1'-0" for plans, and details. Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, and occupancy of each area, including ceiling and roof heights as required by NFPA 13.

7. Design shall be based upon fire protection bid drawings. However, it is the responsibility of the sprinkler contractor to visit the site and prepare working drawings as required.

C. Changes
1. Make no changes in installation from layout as shown on drawings unless change is specifically approved by the Engineer. This does not include minor revisions for the purpose of coordination.

2. Any changes made other than as stated above are at the Contractor's own expense and responsibility.

D. Manufacturers' Data
1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices which are provided or furnished involve work by another contractor, submit additional data copies directly to that Contractor.
   a. Sprinklers and escutcheons.
   b. Pipe, fittings and hangers.
   c. Control valves.
   d. Fireproof caulk.
   e. Waterflow devices.
   f. Valve supervisory devices.
   g. Bell.
   h. Horn.

E. As-Built Drawings
1. Maintain at the site an up-to-date marked set of as-built drawings which shall be corrected and delivered to the Engineer upon completion of work.

2. Upon completion, furnish the Engineer with five (5) sets of blue line prints, one (1) set of reproducible sepia prints, and one (1) set in electronic AutoCad 2007 “DWG” format of each reviewed shop drawing, revised to show "as-built" conditions.

F. Samples
1. Provide samples of each type of sprinkler covers and escutcheons.

G. Final Inspection and Test
1. The Contractor shall make arrangements with the Owner, Architect and Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect and the Engineer will witness the final inspection.

2. Perform all tests and inspections required by the referenced codes and standards, the SFM, CLVFR and the Owner.

3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be paid by the Contractor directly to the engineer prior to rescheduling the final acceptance tests.

4. The Contractor shall provide at least two (2) working days notice prior to all flushing, trip tests and hydrostatic tests. Testing will be scheduled to allow witnessing by the Owner.

5. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate.
H. Operating Instructions
   1. Furnish five (5) copies of NFPA 25 and bound set(s) of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

I. Spare Parts
   1. Provide spare sprinkler cabinets, complete with sprinklers of assorted temperature ratings of the type necessary and in use throughout the installation. Each cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
   2. Install sprinkler cabinet in each riser room.
   3. Confer with the Owner's representative for exact location of cabinet

1.8 GUARANTEE
   A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

1.9 BASE BID, ALTERNATES AND ALLOWANCES
   A. Base Bid
      1. The base bid shall be in accordance with drawings and specifications.
      2. The Contractor shall indicate the number of sprinklers included in the base bid.
   
   B. Alternates
      1. The Contractor shall state in his proposal any proposed contractor substitution of materials or methods of installation from that specified. These alternates shall be listed on the proposal as "Contractor Alternatives."

   C. Overtime Work
      1. State in bid the extra amount to be charged for each hour of overtime work for each apprentice, fitter, foreman, supervisory person, etc., that might be working on this installation.
      2. State the amount included in the base bid caused by anticipated overtime.
      3. Overtime work must be authorized in writing by the Owner's representative.

1.10 PRODUCT DELIVERY
   A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.

   B. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.

   C. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

1.11 QUALITY ASSURANCE
   A. Testing Agency: All material shall be UL listed or FM approved.
B. Regulatory Agencies: State and local building codes and ordinances, State, City of Las Vegas Fire & Rescue and the Owner requirements shall apply.

C. The Contractor shall be fully experienced and licensed in all aspects of the fire protection systems herein specified.

D. Similar materials shall be from a single manufacturer.

1.12 JOB CONDITIONS

A. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.

B. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage. Water shall not be introduced into the system during conditions where there is danger of freezing.

1.13 EMERGENCY SERVICE

A. The Contractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the Owner during the warranty period. This service shall be available on a 24-hour per day, seven-day per week basis.

1.14 TRAINING

A. The Contractor shall conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a mutually agreeable time to the Contractor and the Owner.

1.15 PERMITS AND FEES

A. Obtain and pay for all permits, fees and charges required for this work.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components shall be used in accordance with the manufacturers’ recommendations and its UL-listing and/or FM-approval.

B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.

C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.2 PIPE
A. Pipe shall be new, designed for 175 psi working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.

1. Steel: Steel piping shall be galvanized, where exposed to atmosphere.
   a. Standard Wall: Overhead pipe used inside the buildings, shall be black steel and must comply with the specifications of the American Society for Testing and Materials, ASTM A 795 for black pipe, and hot dipped zinc coated galvanized welded and seamless steel pipe for fire protection use. Galvanized pipe shall be used where exposed to atmosphere. Dimensions for all overhead pipe must be in accordance with the American Standard for Wrought Steel and Wrought Iron Pipe ANSI B36.10-1975 for pressure up to 300 psi. Schedule 40 pipe is considered "standard wall" pipe. Schedule 30 pipe is acceptable in sizes 8-inch and larger. Pipe ends shall be welded, threaded or cut grooved.
   b. Light wall piping shall not be used.

2.3 FITTINGS

A. Changes of direction shall be accomplished by the use of fittings suitable for use in sprinkler systems and defined in NFPA 13. Bushings shall not be used.

1. Pipe shall be joined by screwed joints in accordance with ANSI B 2.1 (ANSI b 1.20.1 - 1983) per NFPA 13, or by welded joints in accordance with ANSI 31.1 as amended or by NFPA 13 approved mechanical fittings. Couplings may be of the rolled groove type or the mechanical locking type (push-on), and they shall be dimensionally compatible with the pipe. Pipe end preparation for the mechanical locking type couplings will be in accordance with the manufacturer's recommendations.

2. Screwed fittings shall be cast iron, 125 pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 150 pound class, black and in accordance with ANSI B 16.3.

3. Flanged fittings shall be cast iron, short body, Class 125, black and in accordance with ANSI B 16.1. Gaskets shall be full-face of 1/8-inch minimum thickness red sheet rubber. Flange bolts shall be hexagon head machine bolts with heavy semi-finished hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B18.2.


5. Push-end fittings shall not be used.

B. Grooved fittings, valves and pipe shall be joined using rubber gasketed couplings produced by the manufacturer of the fittings and/or valves. Gaskets shall be listed for use for the appropriate application (water or dry pipe system). Victaulic "Zero-flex" or equivalent. Rigid grooved couplings shall be used where horizontal piping runs require more than two couplings per run. Rigid grooved couplings shall be used in standpipes (not in earthquake zones).

2.4 SPRINKLERS

A. Light hazard system areas will utilize quick response, ordinary temperature sprinklers.

B. The approximate number of sprinklers and types are shown on the drawings. If the number of sprinklers indicated in the sprinkler count summary differs from actual count on plans, the actual count shall be provided.

C. Install intermediate and high temperature sprinklers of proper degree rating wherever necessary to meet the requirements of NFPA 13.

D. Listed corrosion-proof sprinklers shall be installed in all areas exposed to corrosive conditions.

E. All sprinklers shall be both UL-listed and FM-approved.
2.5 OTHER COMPONENTS

A. Valves and Devices: All sprinkler control valves, devices, valves, etc., shall be approved or listed.

B. Signs
   1. Provide standard metal signs in accordance with NFPA 13.
   2. Provide hydraulic information sign(s) at riser(s) in accordance with NFPA 13.

C. Hangers
   1. All hanger components shall be of the approved and listed type.
   2. Below concrete construction, inserts, expansion cases or Phillips-type shells shall be installed to support the 1-inch through 4-inch size sprinkler piping.
   3. Below concrete construction, inserts shall be installed for all 5-inch, or larger piping, or, in lieu of the inserts, expansion cases, spaced not more than 10 feet apart may be installed in accordance with NFPA 13.
   4. Below steel deck and joist construction, use beam clamps to hang piping from top chord or joist. Do not hang piping from bottom chord, or bridging.

D. Earthquake Bracing Steel shapes listed in NFPA 13 shall be limited to maximum length indicated. When other shapes are provided, slenderness ratio shall not exceed 200 in accordance with NFPA 13. The Contractor shall submit calculations with shop drawings indicating least radius of gyration and maximum permissible length for each shape.

2.6 UNDERGROUND PIPING

A. All underground pipe and fittings shall be pressure centrifugally cast ductile iron enameline or cement lined mechanical joint, "Tyton" joint, or approved equal. Pipe shall conform to ANSI standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General
   1. Clean-up
      a. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
      b. At the completion of the work, remove all surplus materials, tools, etc., and leave the premises clean.
   2. Safety
      a. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
      b. Contractor shall attend all job site safety meetings.

B. Fire Sprinkler Systems
   1. Overhead Piping
      a. All sprinkler piping, drain and test piping, fire department connection piping, etc.; exposed to weather shall be galvanized. All sprinkler piping must be substantially supported from building structure and only approved types of 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 or from steel angles supporting ductwork in accordance with NFPA 13.
      b. Sprinklers below ceilings which are on exposed piping shall be listed and approved regular bronze upright type, in upright position.
c. Sprinkler piping shall be installed above drop ceilings except as noted otherwise. Install sprinkler piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.
d. Install sprinklers as required by NFPA 13 with regard to ducts, obstructions and partitions.
e. Complete sprinkler installation and place in service during nonworking hours in all areas where merchandise or fixtures are stored or in place.
f. Provide sprinkler protection before combustible contents are moved into building.
g. Install paired flanges and numbered test blanks to provide partial protection during construction. Maintain a "test blank log," as shown on drawing, at the site during construction to assure removal of all blanks at completion of job.

C. Drains
1. Provide main drain valves at system control valves, sized in accordance with NFPA 13 and extend piping to the outdoors.
2. Provide all auxiliary drains where necessary.
3. Pipe all drains and auxiliary drains to locations where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel. Piping to roof drains is preferred. Drains may not outlet on walks but may outlet into planters or vehicular paving. Run drains below grade through curb faces where required to avoid outletting on walks. Provide concrete splash blocks where drains outlet into planters.
4. Plugs used for auxiliary drains shall be brass.
5. All piping and fittings downstream of drain valve shall be galvanized.
6. High and low pressure drains shall not be connected together.

D. Electric Alarm Bells
1. Provide one 110-volt 10-inch weatherproof outdoor electric alarm bell vane type D.P.D.T. waterflow switch arranged to activate for all systems.

E. Sleeves
1. Set sleeves in place for all pipes passing through floor or wall openings.
2. Space between sleeve and pipe shall be filled with noncombustible packing.
3. Sleeves through floors shall be watertight.

F. Flushing Connections

G. Fire Department Connection
1. Install fire department connections properly connected to piping with necessary check valve and ball drip drain connection.
2. Provide standard nameplates marked “Standpipe” and “Automatic Sprinklers.”

H. Inside Control Valves
1. Provide OS&Y gate valves at the supply side of the wet pipe system manifold.
2. Provide post indicator valves.
3. Suction control valves for fire pump shall be indicating gate valve.
4. Submit complete manufacturer’s data, including type, number and sizes of control valves, to the Alarm Contractor.

I. Sprinkler Head Locations
1. Suspended acoustical tile ceilings: Sprinkler heads are to be at the center of ceiling tiles in the 2-foot, 0-inch direction and at the 3/4-inch point in the 4-foot, 0-inch direction so that the sprinkler head would be centered in a 2-foot by 2-foot half portion of the ceiling tile.
2. Contractor shall allow for adjustments to his sprinkler heads where aesthetic placement is a concern. Locations such as at special ceilings, light coves, lighting fixtures, etc., may require relocation and the addition of sprinkler heads.

3. Contractor shall review and consider the location and number of vents, duct utilities, framing members, etc., in design as well as construction of the sprinkler system. Extra changes will not be granted to the Contractor to adjust the sprinkler system to fit the build. Reasonable coordination requests are expected and will be reviewed by the Architect.

3.2 WELDING

A. No field welding of sprinkler piping shall be permitted.

B. Headers, risers, feed mains, cross-mains, and branch lines, may be shop welded using acceptable welding fittings. Welding methods shall comply with all the requirements of AWS D10.9, "Standard for Building Service Piping," Level AR-3. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler systems.

C. Provide a blind flange at each end of welded header.

D. Certify welders or braziers as being qualified for welding and/or brazing in accordance with the requirements of AWS D10.9, Level AR-3.

3.3 EARTHQUAKE PROTECTION

A. Provide listed flexible couplings in risers, feed mains and cross-mains, and approved sway bracing for risers, feed mains and cross-mains in accordance with NFPA 13.

3.4 INSPECTOR’S TEST

A. Provide inspector's test connections, as specified in NFPA 13, at required points for testing each waterflow alarm device. Special discharge nozzle shall have same size orifice as smallest orifice sprinklers installed.

B. Provide 1-inch sight glass if inspector's test discharge cannot be readily observed while operating valve.

C. Pipe all inspector's test connections discharging to atmosphere to location where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.

D. Splash blocks shall be provided where inspector's test discharge could produce damage to surroundings.

E. All pipe and fittings downstream of inspector's test valve shall be galvanized.

F. Consult with Owner’s Representative at job for exact location of inspector’s test connections and discharge locators.

3.5 SPRINKLER GUARDS

A. Provide guards on sprinklers within seven (7) feet of finished floor or wherever sprinklers may be subject to mechanical damage, such as the gym areas and locker rooms.

3.6 SPECIALTY DEVICES
A. Installation of all specialty devices shall be in accordance with manufacturers’ instructions. Where the installation of those devices require use of a torque wrench or other appliance, the Contractor shall certify that the manufacturers’ instructions have been complied with.

3.7 UNDERGROUND PIPING

A. Clamp and thrust block all underground piping where required, in accordance with the requirements of NFPA 24 and local requirements

3.8 EXCAVATION AND BACKFILLING

A. General

1. Perform all excavation, including necessary shoring, and all backfilling required for the completion of work under this contract that is to be installed underground, outside, or within building walls. The arrangement of shoring shall be such as to prevent any movement of the trench banks and consequent strain on the pipes.

2. Place all surplus dirt where directed by the Owner’s Representative.

B. Excavation

1. Excavate to the required depth and grade to the bottom of the trench to secure the required slope.

2. Rock or concrete, where encountered, shall be excavated to a minimum depth of 6 inches below bottom of pipe.

3. Where mud, cinders or otherwise unstable or undesirable soil is encountered in the bottom of the trench, such soil shall be removed to firm bearing and the trench shall be backfilled with sand or bank run gravel to the proper grade and tamped to provide uniform firm support.

4. When water is encountered in the trench work, furnish and operate necessary approved pumping equipment and provide approved drainage facilities to keep excavation free of water.

5. The width of the trench at a point 1 foot above the top of the pipe shall not exceed four-thirds the outside diameter of the pipe, plus 8 inches.

6. Piping shall be buried to a depth with not less than 3 feet, 6 inches of cover.

C. Backfilling

1. The pipe joints shall remain exposed until the pipe has been tested by the Contractor and test witnessed by the Owner’s representative(s) and any local authorities having jurisdiction thereof.

2. Remove all material used in shoring or trench banks before backfilling. Backfill consisting of sand or bank run gravel shall be placed to a depth of 1 foot above the top of the pipe and compacted by hand tamping. Backfill for the remainder of the trench shall consist of clean excavated material, free of rocks, stones or debris.

3. The Contractor shall be responsible for the entire work, but shall engage trades specializing in backfilling.

4. Submit certificates from a testing laboratory certifying that the backfilling and compaction thereof is in accordance with the requirements, before final pavement is installed.

END OF SECTION
SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Basic Mechanical Requirements applicable to Division 15 sections in addition to General requirements of Division 1.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 - Specifications sections apply to all work.

1.3 MECHANICAL INSTALLATIONS:

A. The requirements of this Section apply to all the Work of Division 15.

B. The lateral design, including bracing and anchorage, of all mechanical units, ducts and piping shall be per structural drawings.

C. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the Architect for his decision. The decision of the Architect is final.

D. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.

E. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.

F. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.

1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Proposed Products List: Include Products specified in 15000 series specifications.

C. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.

D. Mark dimensions and values in units to match those specified.

E. Submit miscellaneous items specified on the drawings but not covered in the specifications.
Make no substitutions without prior approval from the Engineer.

1.5 REGULATORY REQUIREMENTS:

A. Requirements of Regulatory Agencies:
   1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Divisions 1 and 2, Section IX, Welding Qualifications.
   2. ASHRAE.
   3. UL Publications.
   4. ASTM.
   5. ANSI B31.1, "Code for Pressure Piping".
   6. TEMA.
   7. OSHA.
   8. EPA.
   9. ARI.
   10. NFPA.
   11. UMC.
   12. UPC.
   13. IBC

1.6 PROJECT/SITE CONDITIONS:

A. Install Work in locations shown on Drawings, unless prevented by Project Conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes of Work specified in other Sections. Obtain permission of Engineer before proceeding.

1.7 DEFINITIONS:

A. "Provide" and "Install" means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Provide standard products of a manufacturer regularly engaged in manufacturer of the indicated product. Where more than one unit is required of any product, provide products by the same manufacturer, except where otherwise indicated. Provide products in accordance with manufacturer's recommendations. In the event of a conflict between plans and specifications and the manufacturer's recommendations, notify the Architect immediately.

B. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.

C. Owner may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.

D. Repair and refinish work damaged by the Work of this Division, to Owner's satisfaction. Obtain finishing materials from equipment manufacturer.
2.2 MATERIALS:

A. Electric Motors
   1. General
      a. All fan and pump motors except two-speed motors 5 HP and larger shall be of
         the premium efficiency type. Guaranteed minimum full load efficiencies shall be
         certified in accordance with Institute of Electrical and Electronic Engineers
         (IEEE) Standard 112 Test Method B, National Electrical Manufacturing
         Association (NEMA) MG-1-12.53a.
      b. Electric motors shall be open drip-proof, continuous duty, 40°C. rise type with
         Class "B" insulation, NEMA design B unless specified otherwise. Motors shall
         be of premium efficiency type, and 1.15 service factor.
      c. Three phase motors shall have regreasable ball bearings.
      d. Motors shall have a power factor of 0.9.
   2. Motors installed in outdoor locations shall be totally enclosed, fan cooled and
      continuous duty rating at 55°C., 1.00 service factor.
   3. Where motor is an integral part of equipment, motor manufacturer shall be as
      recommended by the equipment manufacturer.
   4. Motors shall in all cases have adequate starting torque to bring driven equipment up to
      rated speed in a time interval acceptable to the Architect.
   5. Motors greater than 1/2 HP shall be 460 volt, 3 phase, 60 Hertz of NEMA design B,
      NEC Code F or lower in-rush.
   6. Motors 1/2 HP and smaller shall be 115 volt, single phase, 60 Hertz of NEMA design B,
      Code F or lower with internal thermal protection.
   7. Control Panels: Where specified, panels shall be a NEMA 3R enclosure prewired for
      one point feeder supply connection and shall include the following:
      a. Across-the-line magnetic type starter with overload protection and HOA
         switches.
      b. Fused switches with dual element fuses.
      c. Control transformer with fused primary and fused secondary protection.

2.3 COUPLINGS:

A. Couplings for direct drive equipment shall be flexible, self-aligning, non-lubricating type, rated at
   least 125% of motor rated horsepower.

B. Coupling halves shall be keyed and locked on shafts.

C. Manufacturer: Couplings shall be Fast's Standard, or John E. Lisee Pump, Inc.

2.4 BELT DRIVES:

A. General
   1. Belt drives shall be V-belt type with appropriate sheaves.
   2. Minimum of two belts per drive.
   3. Motors 15 HP and smaller shall be provided with variable pitch sheaves and installed
      on motor slide rails.
   4. Motors 20 HP and larger shall have nonadjustable drive sheave and be installed on
      motor slide rails.
   5. After air balance is completed and air balance has been accepted by the Engineer/
      Architect change each variable pitch sheave to fixed pitch sheave.
   6. Manufacturer: Sheaves and belts shall be Browning, Dodge, or Gates.

B. Sheaves
   1. Sheaves shall be cast iron, machined and balanced.
   2. Variable pitch sheaves shall be selected for midpoint of equipment operating capacity.
   3. Sheaves shall be keyed and located on shafts, with Allen head set screws. On
fractional horsepower motors on NEMA frame size 48, smaller sheaves may be secured to shaft with set screws only.

C. Ratings
1. Belt drives for one and two cylinder reciprocating compressors: Minimum horsepower rating, at design speed, of 1.7 times the motor nameplate horsepower rating.
2. All other belt drives: On each two belts drive, each belt shall be rated for motor nameplate horsepower rating. On three belt or greater, drive shall be rated for 150% of motor nameplate horsepower rating.

2.5 GUARDS:
A. General: All rotating elements on equipment shall have protective devices in accordance with the CCR Title 8, Division of Industrial Safety and General Industry Safety Orders and OSHA requirements.
B. Coupling guards shall completely enclose the rotating coupling and shall be constructed of heavy gage steel in accordance with OSHA requirements.
C. Belt Guards
1. Guards shall totally enclose the belts and sheaves. Guards shall be fabricated of galvanized expanded metal sides, solid galvanized steel band and adequately sized galvanized angle iron frame.
2. Adequate room for belt adjustments shall be provided.
3. Tachometer holes with covers shall be provided for both sheaves.

2.6 FIRE STOPPING MATERIALS:
A. Provide fire stopping in accordance with products specified in Division 7 for installation as required for mechanical and plumbing penetration through fire rated walls and slabs.

2.7 ACCESS PANELS:
A. Do not place products including valves, traps, controls, unions, dampers, coils, air distribution boxes, cleanouts, junction boxes, pull boxes, and expansion joints at locations that will be inaccessible after construction is completed. Maintain accessibility for all components in systems. Panel shall be sized for proper service not less than twelve inches (12") x twelve inches (12"). Submit Shop Drawings for approval.
B. Provide access doors complying with Division 8 for items located above finished ceilings, ceiling breaks or extensions behind finished walls or below finished floor.

2.8 SLEEVES:
A. Provide sleeves in locations where pipes or conduit pass through floors, walls, partitions, structural members and roof. Do not make openings that impair strength, function or esthetics of the Work. Notify the Architect and Structural Engineer prior to any cutting Work. All sleeves shall be compatible with piping material that passes through them.
B. Provide pipes passing through floors, walls, partitions, roofs or concrete beams with sleeves having internal diameter 1 inch larger than outside diameter of pipe, and insulation except for sleeves connecting buildings that shall be 1-1/2 inch larger.
C. In sleeves passing through firewalls or floors, or lightproof or soundproof walls, floors and partitions, pack space between sleeve and pipe or insulation with non-shrink grout, ceramic fiber or other approved sealant materials. Install rigid calcium silicate insert on insulated pipe. Approved prefabricated assemblies, Pipe Shields or equal, are acceptable.
D. Sleeves through outside walls or through slab-on-grade, except soil pipe through slab: Provide Schedule 40 black steel pipe with 150 lb. black steel slip on welding flange welded at center of sleeve and painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2-inches of each face of wall. The remaining space shall be packed and sealed watertight with waterproof compound. Fabricated seals, Thunderline link-Seal or equal, are acceptable. This paragraph does not apply for sleeves connecting buildings.

E. Sleeves through masonry or concrete floors or interior masonry or concrete walls. Provide Schedule 40 black steel pipe, set flush with finished wall or ceiling surfaces, but extending 1-inch above finished floors.

F. Sleeves passing through roof construction: Extend minimum 8-inches above roof, flash and sealed water-tight with safe support of conduit and equipment furnished under each division.

G. Sleeves through interior walls other than masonry or concrete: Provide 12 gauge galvanized sheet steel, set flush with finished surfaces of partitions.

H. Sleeves passing through membrane waterproofing or lead safe: Provide 16 ounce soft sheet copper or four-pound lead flashing extending 12-inches beyond sleeves in all directions; secure to waterproofing or lead safe, turn down flashing into space between pipe and sleeve; insert oakum gasket, pour lead, caulk water-tight.

I. Un-insulated copper pipe through ferrous sleeves or in contact with cement or concrete: Wrap pipe with two layers of heavy plastic protective tape. Finish wrapping flush with sleeve ends.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL:

A. General: Excavation and backfill, if required to install the Work specified in this Division shall be performed in compliance with the following requirements.

B. Excavation: Bury piping outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.

C. Backfilling: Do not backfill until final inspection and approval for the piping installation.

3.2 PROTECTION, CARE AND CLEANING:

A. Protection: Protect all finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until completion.

B. Care: During construction, cap all lines and equipment nozzles so as to prevent the entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint and other work by covering it with polyethylene sheets.

C. Cleaning: After installation has been completed, clean all systems as follows:
   1. Ductwork, Piping and Equipment to be insulated: Clean exterior to remove rust, plaster, cement and dirt before insulation is applied.
   2. Ductwork, Piping and Equipment to be painted: Clean exterior of piping and equipment exposed in completed structure, removing rust, plaster, cement and dirt by wire brushing. Remove grease, oil and similar materials by wiping with clean rags and suitable solvents. Any piping not detailed to be painted shall be primed with approved primer after wire brushing.
3. Motors, pumps and other items with factory finish: Remove grease and oil, and leave surfaces clean and polished.

3.3 EXAMINATION AND EXISTING WORK:

A. Examine Specifications, Drawings and the site and become familiar with conditions affecting Work, and consult and cooperate with contractors, subcontractors, sub-subcontractors and installers. Owner reserves the right to determine space priority in the event of interferences.

B. If Work is installed without coordinating with others, and such installation interferes with their installation, make changes necessary to correct the conditions at no cost to Owner.

C. Protect existing services including water, gas, sewer, and electric against damage. If Work makes temporary shutdowns of services unavoidable, consult with Owner as to dates, procedures, and estimated duration of shutdown period at least ten working days in advance of the date that the Work is to be performed.

D. Arrange Work for continuous performance to assure that existing operating services will be shut down only during the time required to make necessary connections. If a system cannot shut down, install temporary bypasses or jumpers until connections are complete.

E. If existing active utility services are encountered which require relocation, make request to proper authorities for determination of procedures. Properly terminate existing services to be abandoned in conformance with requirements of authorities having jurisdiction and utilities.

F. New equipment shall remain the property of the Owner and shall be stored on site.

G. Where connections or disruptions are made to existing systems, reactivate, refill and recharge all components and restore systems to the same operating conditions prior to the time of disruption.

3.4 LUBRICATION:

A. Upon Completion of the Work and before turning over to the Owner, clean and lubricate all bearings except sealed and permanently lubricated bearings.

B. Use only lubricant recommended by the manufacturer and as listed in the Service Manual.

C. Maintain lubrication of all mechanical equipment specified in this Division until Work is accepted by the Architect.

3.5 PAINTING:

A. Painting is specified in Division 9.

3.6 CUTTING AND PATCHING:

A. Cut completed construction Work with specific permission of the Owner. Do not cut reinforcing steel without specific permission of Owner and Structural Engineer.

B. Provide sleeves, caps, plates, escutcheons, flashing, etc., required to fill or close the openings. Provide final grouting, concrete, asphalt, masonry, painting and other materials as required. Make repairs in like and kind for exact patching or surfaces and finishes.

C. Where cutting and patching occurs in streets, sidewalks, alleys and the like, cooperate fully with Owner and municipal or other government bodies.
3.7 CONCRETE WORK:
A. General: Refer to Division 3.
B. Housekeeping Pads and Isolation Bases
   1. Furnish dimensional drawings for all required bases and pads and location thereof.
   2. Furnish all embedded anchor bolts and sleeving and verify installation of same.

3.8 EQUIPMENT BASES AND SUPPORTS:
A. Provide housekeeping pads of concrete, minimum 5 inches thick and extending 6 inches beyond supported equipment Refer to Div. 3.
B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
C. Construct supports of steel members or Steel pipe and fittings. Brace and fasten with flanges bolted to structure.
D. Provide rigid anchors for pipes after vibration isolation components are installed.
E. The lateral design, including bracing and anchorage, of all mechanical units shall be per structural drawings.

3.9 FLASHING:
A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
C. Flash floor drains in floors with topping over finished areas, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device. Seal drains watertight to adjacent materials.
D. Provide acoustical sleeves around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
E. Provide curbs for mechanical roof installations 16 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints. Curbs shall be provided by Division 7 where requested on the drawings. All other curbs shall be field fabricated.
F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.10 SLEEVES:
A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install one piece chrome plated brass escutcheons at finished surfaces.

3.10 OPERATIONAL TESTS:

A. A testing and balancing firm will be employed under a separate contract to carry out full acceptance tests.

B. All equipment shall be provided ready for acceptance tests to be carried out. Any changes which are required to enable equipment to perform to the requirements of the design shall be provided under Division 15. This shall include but not be limited to items such as pulleys, sheaves, and shim adjustment and impeller changes.

C. Systems shall be operable and capable of maintaining continuous uninterrupted operational service during the operating and demonstration periods of operation.

D. All rotating equipment shall be in dynamic balance and alignment.

E. Make all required adjustments to or replacement of the pulleys, belts, drives, sheaves, dampers, balancing valve, motors or the addition of dampers, balancing valves as required for proper equipment and system operation to achieve the capacities specified or scheduled on the Drawings as recommended by the testing agency, at no additional cost to the Owner.

3.11 SERVICES:

A. General: Perform service on all Mechanical Work after original installation for a period of one year of completion including oiling and greasing, adjustments, cleaning, packing of seals, and other items as recommended by equipment manufacturer in the maintenance manual.

B. Air Filters
   1. Do not operate air-moving equipment having air filters unless temporary filters, of similar rating to specified, are in place to protect the Mechanical Work.
   2. Replace these temporary filters with specified filters before final test and balance work is begun as necessary for accurate readings. After completing the testing and balancing work, replace filters with new filter media as specified.

C. Strainers: Remove, clean and reinstall each strainer screen as specified below after systems have been flushed as specified in this section.
   1. Clean each strainer screen after all adjustments have been made and system has operated a minimum of 24 hours, but before final test and balancing operation is started.
   2. Clean each strainer screen again, after final test and balancing operation and before completion of the Project.
   3. Remove flushing screens if provided, set next to pumps.

D. Purge air from water systems after each servicing. Protect furnishings and finishes during each servicing operation and repair or replace to original condition those damaged as a result of servicing.

E. Replace insulation removed or damaged after each operation. Use insulation as specified in Section 15250.

F. Put system in full operating condition.
G. Provide labor, materials, instruments and power required for testing under respective Sections for Work.

H. Test shall be performed to satisfaction of Owner and regulating authority having jurisdiction. Submit to Owner written certificates that tests have been performed in accordance with Specification requirements.

I. Pressure test piping before connection to equipment. No piping equipment or accessories shall be subjected to pressures exceeding their rating.

J. Repair or replace defective Work and repeat tests until systems, and component parts comply with requirements of Contract Documents and authorities having jurisdiction. Damages resulting from tests shall be repaired and damaged material shall be replaced.

K. Test equipment and systems through the full range of parameters specified and shown on the Drawings. Tests shall be performed on individual equipment, systems and their controls. Whenever the equipment or system under test is inter-related with, and depends upon the operation of other equipment or systems and their controls for proper operation, functioning, and performance, test equipment or systems with related equipment or systems shall be operating simultaneously.

L. Do not close up, fur-r- in, or cover before testing and Inspection by Owner/Architect.

M. Test systems as specified under applicable Sections. Duration of tests shall be determined by the authority having jurisdiction and in no case less than the time specified.

N. Drain water used for testing from the system after tests are complete. Repair or replace any damages caused by freezing of water left in system.

O. Make all required repairs to or replacement of the pulleys, belts, drives, sheaves, dampers, balancing valves, motors or the addition of dampers, balancing valves as required for proper equipment and system operation to achieve the specified or scheduled on drawings capacities as recommended by the testing agency, at no additional cost to the Owner.

3.12 EMERGENCY REPAIRS:

A. Provide the OWNER with a contact name and 24 hour telephone number for emergency repairs.

3.13 INSTRUCTIONS FOR OWNER’S PERSONNEL:

A. Prior to acceptance of Work and during time designated by Owner, provide necessary qualified personnel to operate each system for period of five consecutive full working days.

B. During operating period, fully instruct Owner’s personnel in complete operation, adjustment and maintenance of each respective installation as specified in each respective Section.

C. The Contractor shall provide videotaped instructions to the Owner in addition to each training session.

3.14 PROTECTION AND CLEANING:

A. The Work of each Section includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items. No food, smoking or chewing tobacco in building confines.
B. During the course of construction, cap all ducts, pipe and electrical conduit in approved manner to ensure adequate protection against entrance of foreign substances.

C. Disconnect, clean and reconnect, whenever necessary, to located and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.

D. Protect all finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until completion.

E. During construction, cap all lines and equipment nozzles so as to prevent the entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint and other work by covering it with polyethylene sheets.

F. Cleaning: After installation has been completed, clean all systems as follows:
   1. Ductwork, Piping and Equipment to be insulated: Clean exterior to remove rust, plaster, cement and dirt before insulation is applied.
   2. Ductwork, Piping and Equipment to be painted: Clean exterior of piping and equipment exposed in completed structure, removing rust, plaster, cement and dirt by wire brushing. Remove grease, oil and similar materials by wiping with clean rags and suitable solvents.
   3. Motors, pumps and other items with factory finish: Remove grease and oil, and leave surfaces clean and polished.

3.15 EQUIPMENT AND MATERIAL SUBSTITUTIONS:

A. The first named manufacturer listed for materials in this Division is the basis of design. The other named manufacturers may be deemed acceptable substitutions providing that the contract requirements are satisfied and full substitution information is submitted within 30 days of contract award.

END OF SECTION
SECTION 15060
PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 WORK DESCRIPTION:
A. Provide all piping and pipe fittings necessary for complete installation as indicated on the Drawings and as specified.

1.2 RELATED WORK:
A. Division 8 - Access Doors.
B. Division 9 - Painting.
C. Section 15190 - Mechanical Identification.
D. Section 15240 - Vibration Isolation and Seismic Control.
E. Section 15250 – Mechanical Insulation.
F. Section 15510 - Hydronic Piping.

1.3 REFERENCES:
B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
D. ASTM B32 - Solder Metal.
E. ASTM B88 - Seamless Copper Water Tube.

1.4 QUALITY ASSURANCE:
A. Conform to ASME B31.9 code for installation of piping system.

1.5 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Submit manufacturer's technical product data and installation instructions for each type of pipe, pipefittings, and solder and flux.
C. Piping schedule showing manufacturer, pipe weight, fitting type, and joint type for each piping system.

1.6 DELIVERY STORAGE AND HANDLING:
A. Deliver, store, protect and handle products to site under provisions of Division 1.
PART 2 - PRODUCTS

2.1 MATERIALS:

A. All piping and accessories shall be manufactured in the U.S.A.

B. Black Steel Pipe and Fittings for Steel Pipe
   1. Standard Weight Steel Pipe

<table>
<thead>
<tr>
<th>Diameter Inches</th>
<th>Manufacturing Methods</th>
<th>Wall Thickness</th>
<th>ASTM Grade</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8 thru 2</td>
<td>Threaded</td>
<td>Schedule 40</td>
<td>A-53</td>
<td>A or B</td>
</tr>
<tr>
<td>2 1/2 thru 10</td>
<td>Welded or Seamless</td>
<td>Schedule 40</td>
<td>A-53</td>
<td>A or B</td>
</tr>
</tbody>
</table>

C. Unions and Flanges
   1. Provide 150 psig. class malleable iron with bronze or brass to iron ground joints for 2 inch and smaller pipes.
   2. Provide unions over 2 inches of forged steel 150 psig. class raised face weld neck or slip-on flanges conforming to ASTM A 181 and ANSI B 16.5.

D. Ductile Iron Pipe and Fittings for Ductile Iron Pipe
   1. Cast Iron Drainage Pipe and Fittings: Joints shall be made with hubless pipe and fittings, using a neoprene sealing sleeve and stainless steel clamp and shield assembly.
      a. Minimum weight in pounds for single hub 5 foot lengths shall be as follows:

      | Size, Inches | Service Weight, Pounds |
      |--------------|------------------------|
      | 2            | 20                     |
      | 3            | 30                     |
      | 4            | 40                     |
      | 5            | 55                     |
      | 6            | 65                     |
      | 8            | 100                    |
      | 10           | 145                    |
   b. Furnish fittings, specials, and miscellaneous lengths in the same thickness class as herein specified for 5 foot lengths.

E. Copper Tube and Fittings for Copper Tube
   1. Copper Water Tube and Fittings
      a. Furnish seamless copper water tube conforming to the requirements of ASTM B 88 in weight K or L, and temper annealed or drawn as specified. Comply with FS WW-T-799, for refrigeration service.
b. Solder and Flux for Water Piping: High temperature solder with a flow point above 1100 degrees F. shall be used for joining copper tubing and fittings. The flux shall be as recommended by the manufacturer of the solder. One of the following solders, or equal, may be used: Silfos - 1300 degrees F, Flow Point; Easy-Flo #3 - 1270 degrees F, Flow Point, or equal.

F. Fittings for Copper Water Tube
1. Wrought Copper Fittings: Furnish wrought pressure solder joint fittings, pressure fittings conforming in all respects to ANSI B16.22.
2. Cast Bronze Fittings: Furnish cast bronze solder joints pressure fittings conforming in all respects to ANSI B16.18 and same weight as pipe.
3. Provide Brazolets of high silicon bronze conforming to ASTM B283 in sizes 2 inches and smaller, and conforming to MIL STD B-16541 in sizes 2-1/2 inches and larger.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Piping and Fittings: Ream all pipes to full inside diameter after cutting and clean before erection.

3.2 INSTALLATION:

A. General
1. Run all piping as direct as possible, and conceal piping in finished rooms unless shown or specified otherwise. Arrange pipe lines to give ample room for the pipe insulation specified in Section 15250.
2. Make tee connections with standard tee fittings for full size branches. For reduction branches, when branch line is a minimum of 2 pipe sizes smaller than main line, use reducing tees or weldolets and threadolets for steel pipe and brazolets for copper pipe.
3. Make screwed joints with teflon tape or a pipe joining compound, recommended by the pipe manufacturer, applied to the male threads only. Welded joints to be welded as set forth in the standard manual of Pipe Welding of the Heating, Piping, and Air Conditioning Contractors Association.
4. Make joints in copper pipework with solder joints made with 95-5 tin-antimony solder.

B. Installation - Polyvinyl Chloride Pressure Pipe
1. Install polyvinyl chloride pressure pipe in accordance with the AWWA Manual M23 and the manufacturer's recommendations except as otherwise provided herein or shown.
2. Prior to installation, all polyvinyl chloride pressure pipe, couplings, and rubber rings shall be inspected by the Contractor for damage and defects in material and workmanship. All damaged of defective materials shall be rejected and removed from the job site, by the Contractor at no expense to the Owner.
3. Polyvinyl chloride pressure pipe showing signs of physical damage or unacceptable ultraviolet exposure as determined through visual inspection by the Owner may be rejected and then must be removed from the job site.
   a. Material so rejected will be approved for installation, if the Contractor at his sole cost and expense provides the Owner documented test results prepared by a certified testing laboratory showing the rejected pipe to be in conformance with AWWA C900.
4. Use the manufacturer's recommended pipe lubricant when making pipe connections.
   a. Lubricate only the spigot end up, including the reference mark.
   b. The reference mark on the spigot end must be flush with the end of the bell.
   c. Follow AVWVA Manual M23 and the manufacturers recommendations.
3.3 ADJUSTMENT AND CLEANING:

A. After piping is erected, flush all piping before running pumps or sterilizing the potable water system.

B. Clean each system by passing cleaning fluids through pipework. Isolate previously cleaned equipment from the system and do not subject to cleaning fluids.

C. Flush systems completely after cleaning.

END OF SECTION
SECTION 15100

VALVES

PART 1 - GENERAL

1.1 WORK DESCRIPTION:
   A. Provide and install all valves within the building as indicated on the Drawings and as specified.

1.2 RELATED WORK
   A. Section 15510 – Hydronic Piping

1.3 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. Furnish shop drawings, product data for valves.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:
   A. General: Unless otherwise indicated, all valves of all types installed in connection with mechanical piping shall comply with the following:
      1. Provide one make throughout the Project manufactured by Stockham, Crane, Nibco (USA), unless otherwise indicated.
      2. Pack all stems in conformance to ANSI B16.34.
      3. All valves 2 inches and smaller to have bronze bodies and to be threaded.
      4. All valves 2-1/2 inches and larger shall be bronze body mounted (BBM) type and shall be flanged.
      5. Wheel handles to be non-heating style cast from malleable iron ASTM A 197.
      6. Mark each valve at the factory with the following minimum information, engraved, stamped, or cast on each valve or metal tag permanently attached to the valve:
         a. Manufacturer’s Name.
         b. Catalog or Figure No.
         c. Size and Pressure Class.
         d. Arrows shall indicate direction of flow on check, globe, angle, non return, and eccentric plug valves.
         e. UL approved valves and shall bear the UL label.
      7. Unless identified on the Drawings, each valve shall be the same size as the pipe in which it is installed.
      8. Provide extension necks or stems on insulated valves to ensure the valve wheel and handle is exposed.
      9. All valves shall be “U.S.” manufactured.

2.2 BALL VALVES:
   A. Screwed two inches (2”) and smaller, cast bronze body, 125 psi wog, 150 psi .
   B. Valves shall include reinforced Teflon packing ring, thrust-seal, body seals and seats.
   C. Balls shall be stainless steel; with full size ports, 2 piece.
D. Quarter turn on-off, adjustable packing gland and internally inserted stem.

E. 2-1/2 and Larger: Nibco 150 psi. Flanged ball valve, full size ports, 3 piece bronze body and 316 S.S. ball and stem with Teflon seat.

2.3 CHECK VALVES:

A. Size, 2 Inches and Smaller
   1. Provide swing check valves designed for 200 psig non shock water, oil, and gas working pressures. Regrinding valve seats not to require removal of valve from line. Provide screwed caps, renewable side plugs, hinges, and bronze discs. Valves shall operate equally well in the vertical or horizontal position.
   2. Materials: Body made from bronze conforming to ASTM B 61 or B 62. Cap, disc, and hinge made from bronze conforming to ASTM B 61 or B 62, screwed ends.

B. Size, 2-1/2 Inches and Larger
   1. Provide swing check valves designed for 200 psi non shock water, oil, and gas working pressures. Regrinding valve seats not to require removal of valve from line. Provide screwed caps, renewable side plugs, hinges, and bronze discs. Valves shall operate equally well in the vertical or horizontal position.
      a. Materials: Body made from high grade iron conforming to ASTM A 126 Class B. Cap, disc, and hinge made from bronze conforming to ASTM B 61 or B 62, screwed ends.
      b. Manufacturers: Crane 38.

2.4 ECCENTRIC PLUG VALVES (BALANCING VALVE)

A. Provide non lubricated eccentric plug style valves designed for minimum pressure loss in the wide open position. Equip with adjustable opening stops for balancing. Resilient plug facing shall be capable of continuous bubble tight service in water at 250 degrees F.
   1. Furnish valves, sizes 5 inches and smaller designed for 150 psig and valves 6 inches and larger for 125 psig, non-shock water working pressures at 250 degrees F.
   2. Provide with permanently lubricated corrosion resistant bushings in top and bottom bearings.
   3. Provide bodies tapped with a pipe connection on downstream side of seat for pressure gage connection. Equip valves 4 inches and larger with gear actuators. All gearing shall be enclosed, manufactured for running in oil, and the actuator to be submersible with seals provided on all shafts to prevent entry of water into the actuator. Provide all shaft bearings with permanently lubricated bronze bearing bushings. Actuator to clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Ensure valve packing and adjustment is accessible without disassembly of the actuator.

B. Manufacturers – General
   1. DeZurik Valves: Provide with cast iron bodies, bonnets and plugs conforming to ASTM A 126, Class B. Face plugs with De Zurik’s “RS 55.”
   2. Homestead Valves: Furnish Homestead “ballcentric” valves with nickel iron body, cap, and plug, having 1 to 1-1/2 percent nickel content and an average tensile strength of 34,000 psi. Plugs shall be faced with ethylene-propylene terpolymer (EPT).

C. Manufacturer, by Size and Service
   1. Sizes, 2 Inches and Smaller: De Zurik No. 1185, Homestead No. 1512, with permanently attached lever operators.
   2. Sizes, 2-1/2 Inches Through 3 Inches: DeZurik No. 118F, Homestead No. 1522, with permanently attached lever operators.
2.5 BUTTERFLY VALVE:

A. General: 2 1/2 inch through 12 inch - furnish valves designed for 200 psig non shock and 250 degrees F. water service.

B. Valves shall conform to ASTM A-126 Class B cast iron.

C. Valves shall be lug type drilled and tapped for dead end service.
   1. Materials of construction shall be:
      b. Disc - Aluminum Bronze.
      c. Stem - 300 series stainless steel if exposed to flowing media, 400 series stainless or allow steel phosphate coated, if not exposed to flowing media.
      d. Seat - Ethylene Propylene Diene Monomer (EPDM).
   2. Operator shall be a 10-position lever lock for sizes 2-6 inches with a totally enclosed weatherproof acme screw gear actuator for 8 inches and larger infinite adjustment; memory stop options shall be provided.

D. Manufacturers
   1. 2 1/2 to 6 inch: Stockham LG-512-DS3-E, Crane 44-FXZ-TL.
   2. 8 inch and larger: Stockham LG-522-DS3-B, Crane 21-FRB0-G.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install all valves in accordance with manufacturer's printed instructions and as indicated on Drawings.

B. Do not install valves upside down.

3.2 ADJUSTMENT AND CLEANING:

A. Adjust, pack, and replace valves and stops as may be required to eliminate leaks and to meet flow requirements of ASME B31.
SECTION 15120

PIPING SPECIALTIES

PART 1 - GENERAL

1.1 WORK DESCRIPTION:

A. Provide piping specialties as indicated on the Drawings and as specified.

1.2 RELATED WORK

A. Section 15510 - Hydronic Piping.

1.3 REFERENCES:

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

C. Submit inspection certificates for pressure vessels from authority having jurisdiction

D. Manufacturer’s Installation Instructions: Indicate hanging and support methods, joining procedures.

E. The following list includes the required shop drawings that shall be submitted:

1. Vents
2. Strainers

PART 2 - PRODUCTS

2.1 MATERIALS

A. System Specialties
1. Air Vents
2. Install air vents on all points required for efficient operation of system.
3. Install automatic vents as shown in the drawings and where exposed to view.
4. The discharge from all automatic air vents shall be discharged above the nearest floor sink where located in mechanical rooms or exposed areas.
5. The discharge from all automatic air vents in concealed areas shall run to within 12-inches of accessible ceilings or 12- inches of access panels in fixed ceilings. Use 1/4-inch copper water tube ASTM B88, Type K for discharge line.
6. Automatic Vents: Hoffman No. 79, Bell and Gossett No. 87, or equal.
7. Provide air chambers at all high points and intermediate high points in piping with air vent cocks fully accessible. Provide air chambers with diameters same size as pipe and a minimum of 2 inches long except provide same length as diameter for pipes larger than 2 inches. When air vent cocks on air chambers are not fully accessible, extend cocks with 1/4 inch copper water tube ASTM B 88, Type K.
8. Strainers
   a. Provide “y” type strainers throughout the job unless specifically noted otherwise. Provide bronze or cast iron body strainers.
   b. “Y” Strainers. Provide one manufacturer throughout the Project.
   c. Strainers shall be equipped with blowoff valves, with screen sizes as follows:

<table>
<thead>
<tr>
<th>Size, Service</th>
<th>Straining Inches Medium</th>
<th>Screen Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1/4 to 2</td>
<td>1/16</td>
</tr>
<tr>
<td></td>
<td>2-1/2 to 4</td>
<td>1/16</td>
</tr>
<tr>
<td>High Temp.</td>
<td>1/4 to 2</td>
<td>20 mesh</td>
</tr>
<tr>
<td>Hot Water</td>
<td>2-1/2 up</td>
<td>3/64</td>
</tr>
</tbody>
</table>
   d. Strainers - General: Use 150 psig pressure class.
   e. Two inches and smaller. Furnish screwed ends, screwed bronze cap and gasket in sizes 1-1/2-inch and smaller and with a bolted cap on 2-inch size. Screens on water service to be made of monel or stainless steel. Provide iron body strainers Mueller No. 251 FBC or 251 BC, Crane 988-1/2, or equal, except provide bronze strainers in all copper piping Mueller No. 351, Hoffman 420, or equal.
   f. Two and one half inches and up. Furnish flanged ends, bolted gap and gasket, stainless steel or monel screen. Provide cast iron body in steel piping and bronze body in copper piping.
   g. Provide blow off valves on all strainers, with hose connection, cap and chain.

9. Vacuum Breakers:
   a. Watts Regulator Company, Model No. 288, Sloan Valve Company, No. V-300A, or equal with bronze body chrome plated in finished areas.

10. Insulating Couplings:
   a. Provide for the appropriate sizes of cast iron couplings, cast iron fittings or cast iron flanges at all interconnections between piping systems of dissimilar material and at all connections of piping systems to equipment where piping and equipment are of dissimilar materials.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Provide valves at each piece of equipment to provide for isolation of the equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers.

   B. Provide unions adjacent to each screwed type valve and on the outlet side of the valve. Drain all air vents to a floor sink or floor drain.

   C. Provide all piping accessories required for complete installation of Mechanical Work

   D. Install strainers ahead of all automatic valves and elsewhere as indicated on the Drawings. Provide a ball valve with hose connection, cap and chain in the blowoff opening of each strainer.

3.2 ADJUSTMENT AND CLEANING

   A. Adjust all valves and specialties to operate smoothly and without binding or leaking. Test and prove all vents to open freely for the passage of air. Locate strainers as necessary to allow easy cleaning.

END OF SECTION
SECTION 15121
PIPING EXPANSION COMPENSATION

PART 1 - GENERAL
Requirements of the General Conditions and Division 1 apply to this Section.

1.1 WORK INCLUDED
A. Flexible pipe connectors.
B. Expansion joints and compensators.
C. Pipe loops and offsets.
D. Seismic expansion joints.

1.2 RELATED WORK
A. Section 15510 - Hydronic Piping.
B. Section 15410 – Plumbing Piping

1.3 REFERENCES
A. MIL-E-17814E - Expansion Joints, Pipe, Slip-Type, Packed.

1.4 SUBMITTALS
A. Submit under provisions of General Conditions and Division 1 as applicable.
B. Product Data
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
C. Provide shop drawings detailing expansion loops, anchors, support and guide locations, welding to structure and catalog data on expansion joints.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS
A. Steel Piping
   1. Inner Hose: Carbon Steel, Stainless Steel or Bronze.
   2. Exterior Sleeve: Single braided or Double braided stainless steel or bronze.
   3. Pressure Rating: 125 psig WSP and 450 degrees F.
   4. Joint: Flanged, Threaded with Union or Welded.
   5. Size: Use pipe sized units.
   6. Maximum offset: 1 inch on each side of installed center line.
   7. Mechanical grooved couplings shall not be a substitute for flexible pipe connections.
2.2 EXPANSION JOINTS

A. Stainless Steel Bellows Type
   1. Pressure Rating: 125 psig WSP and 400 degrees F.
   2. Maximum Compression: 3 inch.
   5. Size: Use pipe sized units.
   6. Application: Steel piping 3 inch and under.

B. External Ring Controlled Stainless Steel Bellows Type
   1. Pressure Rating: 125 psig WSP and 400 degrees F.
   5. Joint: Flanged
   6. Size: Use pipe sized units
   8. Application: Steel piping over 3 inch.

C. Low Pressure Compensator with Two-Ply Bronze Bellows
   1. Working Pressure: 75 psig; 80 psig.
   2. Maximum Temperatures: 250 degrees F.
   3. Maximum Compression: 1/2 inch.
   5. Joint: Soldered
   6. Size: Use pipe sized units
   7. Application: Copper or steel piping 2 inch and under.

D. Copper with Packed Sliding Sleeve
   2. Maximum Temperature: 250 degrees F.
   4. Size: Use pipe sized units
   5. Application: Copper 2 inch and over.

2.3 Pipe Alignment Guides

A Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 -EXECUTION

3.1 INSTALLATION

A Install in accordance with manufacturer’s instructions.

B Construct spool pieces to exact size of flexible connection for future insertion.

C Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

D Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast.
connections or apparatus.

F Install support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where indicated.

G Install expansion loops as indicated on drawings.

H Install pipe guides for the first three supports upstream and downstream of each expansion device.

I Provide expansion compensators in piping systems where expansion loops cannot physically be installed. Provide pipe guides on all piping with expansion loops. Provide design and installation of all pipe anchors for expansion loops.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of General Conditions and Division 1 as applicable.

B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION
SECTION 15130
GAUGES AND THERMOMETERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Provide gauges and thermometers.

1.2 SHOP DRAWINGS AND PRODUCT DATA SUBMITTALS
A. Thermometers.
B. Pressure gauges.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Pressure Gauges
1. General. Provide pressure gauges manufactured by Ashcroft, or equal, with white dial and black scale. Locate gauges for easy reading. Install gauges as shown on drawings.
2. Each gauge scale range to be such that pointer will be at mid-point at normal operating pressure.
3. Pipe Pressure Gauges: 4-inch dial, corrosion-resistant movement, gauge cock.

2.2 THERMOMETERS
A. Thermometers in Water Systems. Furnish each thermometer with stainless steel, separable socket, 9-inch scale, adjustable angle, red reading mercury, manufactured by Mueller. Thermometers shall have ranges for the service, mounted for convenient reading. Provide extension neck for insulated pipe systems. Insertion length shall be such that socket penetrates pipe a minimum of 75 percent of pipe diameter.
B. Pipe Thermometers: Mercury, 9-inch scale, long stem, separable socket, adjustable.

2.3 MANUFACTURERS:
A. Marsh, Weiss or equal.

PART 3 - EXECUTION

3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION
A. Pipe Thermometer: Locate where indicated in plans.
B. Pipe Pressure Gauges: Locate at inlet and outlet of each water PRV station, main domestic water service at building entrance, and where indicated on the drawings.

END OF SECTION
SECTION 15140
PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:
   A. Provide piping supports, hanger, guides and anchors as indicated on the Drawings and as specified.

1.2 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. Shop Drawings: Indicate system layout with location and detail of pipe hangers installations.
   C. Product Data: Provide manufacturers catalog data including load capacity. Provide piping and equipment supports, hangers and anchors as indicated on the drawings and as specified or as required to meet the intent indicated on the drawings.

1.3 OPERATION AND MAINTENANCE DATA:
   A. Submit operation and maintenance data under provisions of General Conditions and Division 1 as applicable.
   B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.
   C. Submit for pipe supports, hangers and anchors.

PART 2 - PRODUCTS

2.1 MATERIALS:
   A. All hangers, supports and anchors for pressure piping shall be in accordance with the ANSI B-31 and be electrogalvanized finished for protection from moisture and air. No plain "black" material or other materials will be allowed.
   B. Horizontal Piping Hangers
      1. Provide one of the following types of hangers for horizontal piping manufactured by Grinnell, Superstrut, Unistrut, B-Line, Inc., Tolco.
      2. Copper tubing support hangers for uninsulated pipe. Provide Superstrut C716 Isolator, Grinnell, or equal.
   C. Beam clamps shall be malleable iron, Superstrut M775L, Unistrut M29, or equal, clamp with lock nut for 3/8 inch hanger rods, steel beam clamp, Superstrut U564, Unistrut P1648-P1653 Series, for hanger rod up to 3/4 inches. Design load shall not exceed printed loads of U564 with design data safety factor 5.
   D. Inserts: Provide continuous insert channel, with closure strip, Superstrut C302, Unistrut P3249 to 3270 Series, for grid insert system. For single inserts, Superstrut 452, Unistrut M26. Do not exceed hanger rod design load table as published in this section.
E. Saddles and Shields
   1. Saddles
      a. Hot Water Piping Saddles: Provide saddles Grinnell 160, Superstrut, on all hot water systems where water temperature exceeds 110 degrees F.
   2. Shields
      a. Provide shields to protect insulation in all areas where saddles are not specified to protect insulation at areas of contact with hangers and supports.
      b. Provide Superstrut C790, B-Line B3154.

F. Anchors and Guides: Provide anchors and guides as necessary. Guides shall be Grinnell Fig. 256 with Fig. 1007, Keflex Series P.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide hangers to support the required loads. Support to permit movement due to expansion and contraction. Where Drawings indicate details of supports and anchors, conform to details shown. Where details are not shown, conform to requirements of this section.

B. Insulation Protection Shields: Hangers and supports shall fit outside of all pipe insulation and insulation inserts. Provide galvanized steel protection shields centrally located at all hangers and supports of insulated piping. Shields shall be 14-gauge, 12-inch-long and shall cover one-half of the insulation or inserts to prevent any direct contact with hangers or supports. Insert sections shall be provided as specified.

C. Hang pipe from primary building structure. Piping shall not be hung from ceiling deck and other piping. All rigid hangers shall provide a means for vertical adjustment after erection.

D. Where noninsulated pipes, in which vibration may occur, pass through walls, floors, or partitions, encase pipe in acoustical wall sleeves.

3.2 HORIZONTAL PIPING SUPPORT SCHEDULE

A. Maximum spacing between single supports for copper tubing shall be in accordance with table, 15140-A attached at the end of this section.

B. The spacing specified herein is included to limit deflection in the pipe to an acceptable minimum. Shorten intervals as necessary so the support manufacturer's maximum recommended safe load values in accordance with ANSI B 31.1 are not exceeded.

3.3 VERTICAL PIPING SUPPORT

A. Support all vertical piping independent of horizontal piping.

B. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.

C. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.

D. Support all vertical pipes that penetrate the roof deck with unistrut attached to framing member, not deck. The pipe will be supported at the roof deck just below the deck and also minimum 24” below deck with unistrut to prevent rotational movement.
### 3.4 SADDLES

A. After installation, saddles to be filled with Pipe insulation specified in Section 15250.

**TABLE NO. 15140-A**

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>1&quot; dia or under</th>
<th>1 ¼&quot; to 1 ½&quot; dia.</th>
<th>2&quot; to 2 ½&quot; dia.</th>
<th>3&quot; dia. and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel Pipe</td>
<td>6'-0&quot;</td>
<td>10'-0&quot;</td>
<td>12'-0&quot;</td>
<td>12'-0&quot;</td>
</tr>
<tr>
<td>Copper tubing</td>
<td>5'-0&quot;</td>
<td>6'-0&quot;</td>
<td>10'-0&quot;</td>
<td>10'-0&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>1&quot; dia or under</th>
<th>1 ¼&quot; to 2 ½&quot; dia.</th>
<th>3&quot; dia. and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Piping</td>
<td>6'-0&quot;</td>
<td>10'-0&quot;</td>
<td>12'-0&quot;</td>
</tr>
</tbody>
</table>

**Cast Iron:** Support at every joint, each side of no-hub coupling, and 10'-0" maximum.

<table>
<thead>
<tr>
<th>All Thread Rod Pipe Size</th>
<th>Rod Size</th>
<th>Maximum Design Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; and smaller</td>
<td>3/8&quot;</td>
<td>610 #</td>
</tr>
<tr>
<td>2-1/2&quot; to 5&quot;</td>
<td>1/2&quot;</td>
<td>1130 #</td>
</tr>
<tr>
<td>6&quot; to 8&quot;</td>
<td>5/8&quot;</td>
<td>1810 #</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Three phase electric motors.
B. Single phase electric motors.
C. Variable frequency drive.

1.2 REFERENCES:

A. AFBMA 9 - Loaded Ratings and Fatigue Life for Ball Bearings.
B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
D. ANSI/NEMA MG 1 - Motors and Generators.
G. ANSI/UL Std. 508 - Testing by Independent Laboratories.

1.3 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Submit test results verifying nominal efficiency and power factor for three phase motors larger than 20 horsepower.
C. Submit manufacturers’ installation instructions under provisions of Division 1.

1.4 OPERATING AND MAINTENANCE DATA:

A. Submit operation and maintenance data under provisions of Division 1.
B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS:

A. Manufacturer: Company specializing in manufacture of electric motors and adjustable frequency controllers for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
1.6 REGULATORY REQUIREMENTS:
   A. Conform to applicable electric code.
   B. Conform to local energy code.

1.7 DELIVERY, STORAGE AND HANDLING:
   A. Deliver products to site under provisions of Division 1.
   B. Store and protect products under provisions of Division 1.
   C. Protect motors and controllers stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WARRANTY:
   A. Provide one (1) year manufacturer's on-site labor and material warranty for motors and adjustable frequency drives under provisions of Division 1.
   B. Warranty: Include coverage for motors larger than ¾ horsepower.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:
   A. Motors: General Electric, Westinghouse, Baldor, Toshiba/Houston, U.S.
   B. Variable Frequency Drive: Magnetek, Danfoss and ABB.

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS:
   A. Motors: Design for continuous operation in 40 degrees C environment and for temp accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.
   B. Motors installed in outdoor locations shall be totally enclosed, fan cooled and continuous duty rating at 55 degree C and 1.00 service factor.
   C. Controllers Design for operation with the actual motor and driven pumps or fans.
   D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor.
   E. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

2.3 THREE PHASE POWER - SQUIRREL CAGE MOTORS
   A. Starting Torque: Between one and one and one-half times full load torque.
   B. Starting current: Six times full load current.
   C. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B
characteristics.


E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine from the electrical or mechanical defects and compliance with performance data.

G. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provisions for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To NASI/NEMA MG 1.

J. Nominal Efficiency: Meet or exceed values in schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

K. Nominal Power Factor: Meet or exceed values in schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

L. Motors shall deliver full nameplate horsepower without derating due to thermal considerations when on variable frequency power.

2.4 VARIABLE FREQUENCY DRIVE (VFD)

A. Variable Frequency Drive Systems shall be compatible with any standard NEMA B design 3-phase induction motor. Variable Frequency Drive Systems shall be sized to insure the motor full load amps do not exceed the controller continuous RMS amps.

B. The adjustable frequency drive shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three phase, AC power for stepless motor speed motor Control from 10% to 110% of the motors 60 Hz speed. Input voltage shall be as specified on the drawing schedules. The input section of the drive shall include line reactors or isolation transformers as required to meet IEEE 519 for distortion levels of 5% or less. The variable frequency drives shall not interfere with sensitive electronic equipment that is fed from the same power distribution system.

C. The Output wave form shall be either six step or sine coded pulse width modulated. To eliminate acoustical noise, PWM drives shall have a minimum of 2500 pulses per sine. The VFD's input power factor shall be .95 or better at all operating speeds. Efficiency shall be 96% minimum from 0-100% load. To eliminate RFI and EMI, the drive shall comply with FCC rules and regulations, part 15, subpart J.

D. Solid State Ground Fault Protection shall be standard. Those manufacturers that cannot provide this as a standard feature must supply an external protector. Adaptive electronic motor overload protection shall be provided which shall protect both the motor frequencies. Electronic thermal overload circuits which properly protect the motor only at full speed shall not be acceptable. The VFD shall sense the load and speed and shall recalibrate the thermal trip curve to insure low speed motor protection. The initial trip point shall be adjustable from at least 40-100% of the VFD amperage rating.
E. Isolated control inputs shall be provided. The motor speed shall be directly proportional to 0-10 volt, 4-20 mA, and variable resistance signals.

F. Drive operation options shall be switch selectable and shall include at a minimum the following functions:
   1. Automatic reduction in voltage with a reduction of load. This energy saving feature shall not sacrifice acceleration torque.
   2. The VFD shall provide the following operational features:
      3. Speed search transfer. The VFD shall be able to start from bypass or fault trip into a spinning load without stopping the motor or creating a fault condition. The VFD shall match the motor's speed and then drive the motor to its proper speed.
         a. Adjustable current limit threshold.
         b. Multiple restart upon fault trip.
         c. Minimum 10:1 speed ratio.
         d. Individually adjustable acceleration and deceleration patterns, adjustable from 0.1 - 1800 seconds.

G. The VFD shall be suitable for installation and use under the following environmental conditions: 20 to 114 deg.F, 0-90% RH, non-condensing.

H. Fault Indication and Operation:
   1. The following fault conditions shall cause the VFD to shut-off (trip) and shall be annunciated by LED indicators on the control board. FU: Fuse Blown, OC: Instantaneous Overcurrent, OV: Overvoltage, UV: Undervoltage, OH: Overheat EB: External Failure, CPF: Control Function Error, CFP-SEL: Control Function Selection Error, OL: Overload
   2. The VFD shall attempt to restart a minimum of 5 times after tripping on a fault. A dry contact on the VFD shall close after the fifth unsuccessful restart attempt.

I. The VFD shall be equipped with a digital operator interface which shall allow the following functions:
   1. Digital frequency indication on an LCD display.
   2. Digital fault indication on the LCD display. Digital Fault reset. Storage and operator initiated recall of the fault conditions in this sequence of occurrence.
   4. Digital speed control in 0.1 Hz increments.
   5. Tracking of fault/failure history.
   6. Display of frequency or RPM.
   7. Self diagnostics.

J. Manual bypass shall provide all the circuitry necessary to safely transfer the motor from the VFD to the power line, or from the line to the controller while the motor is at zero speed. Two motor contractors, electrically interlocked, shall be utilized. One contractor is to be between the controller output and the motor, controlled by the controller regulator; and the other one is to be between the bypass power line and the motor, providing across-the-line starting. Motor protection is to be provided in both the "controller" mode and the "bypass" mode by a motor overload relay. The 115VA-C relay control logic, allowing common start-stop commands in the controller" mode and the "bypass" mode shall also be included within this enclosure. The bypass shall include a door interlocked, main power input disconnect circuit breaker providing positive shutdown of all input power to both the bypass circuitry and the VFD. The bypass circuit shall include a second door interlocked input disconnect circuit breaker installed in the VFD. This disconnect shall provide the ability to safely troubleshoot and test the controller, both energized, while operating in the "bypass" mode and shall mount within the controller enclosure, in a conditioned space.

K. The VFD manufacturer shall maintain and staff nationwide service centers. Service engineers shall be factory trained, local and certified by the manufacturer and shall provide start up
service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

PART 3 - EXECUTION

3.1 APPLICATION

A. Single Phase Motors need not conform to these specifications.

B. Motors shall be open drip-proof type, except where specifically noted otherwise.

C. Motors shall be energy premium efficient type.

D. Motors located in exterior locations shall be totally enclosed type.

E. Adjustable frequency controllers shall be as scheduled on the drawings.

3.2 PERFORMANCE SCHEDULE: THREE PHASE-OPEN, DRIP-PROOF

A. Motors shall be tested to IEEE-1 12, Method B. Minimum efficiencies and power factors are:

<table>
<thead>
<tr>
<th>HP (Syn)</th>
<th>RPM</th>
<th>NEMA Efficiency</th>
<th>Percent Power Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1800</td>
<td>82.5</td>
<td>63.3</td>
</tr>
<tr>
<td>1-1/2</td>
<td>1800</td>
<td>84.0</td>
<td>83.8</td>
</tr>
<tr>
<td>2</td>
<td>1800</td>
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<tr>
<td>30</td>
<td>1800</td>
<td>92.4</td>
<td>81.8</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES:
   A. Nameplates.
   B. Tags.
   C. Pipe Markers.

1.2 REFERENCES:

1.3 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
   C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
   D. Product Data: Provide manufacturers catalog literature for each product required.
   E. Samples: Submit labels and tags for each system.

1.4 PROJECT RECORD DOCUMENTS:
   A. Record actual locations of tagged valves.

PART 2 - PRODUCTS

2.1 NAMEPLATES:
   A. Description: Manufacturer's standard or laminated three-layer plastic with engraved black letters on light contrasting background color; one inch high with 3/4 inch lettering through light layer.

2.2 TAGS:
   A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter or square with smooth edges.
   B. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 COLOR CODE:
   A. Green - Plumbing piping, systems and equipment including valves.
2.4 PIPE MARKERS:
   A. Color: Conform to ANSI A13.1.
   B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
   C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
   D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS:
   A. Description: Steel with 3/4 inch diameter color coded head.

2.6 MANUFACTURERS:
   A. W.H. Brady, Seton Name Plate.

PART 3 - EXECUTION

3.1 PREPARATION:
   A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION:
   A. Install plastic nameplates with corrosive-resistant mechanical fasteners, screws or rivets only. Consult with Architect when such method conflicts with the manufacturer's warranty and/or requirements.
   B. Install tags with corrosion resistant chain.
   C. Install plastic pipe markers in accordance with manufacturer's instructions.
   D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
   E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
   F. Identify large devices with plastic nameplates or stencil painting. Small devices, may be identified with tags.
   G. Identify control panels and major control components outside panels with plastic nameplates.
   H. Identify valves in main and branch piping with tags.
   I. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape and pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of
penetration of structure or enclosure, and at each obstruction.

J. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape and pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

L. Provide red ceiling tacks ¾” Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

M. Room temperature sensors shall have engraved nameplates on wall adjacent to temperature sensor that identify the room number, zone number and the HVAC unit number that serves that room.

END OF SECTION
SECTION 15240
VIBRATION ISOLATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 WORK DESCRIPTION:
A. Provide all vibration isolators for mechanical equipment to prevent the transmission of vibration and mechanically transmitted sound to the building structure as indicated on the Drawings and as specified. Include adjustments of each mounting system. Provide specific mounting arrangements for each item of electrical equipment as described herein, and as indicated by details on the Drawings.

1.2 RELATED WORK:
A. Division 3 - Concrete.
B. Section 15140 – Pipe Supports and Anchors.

1.3 SUBMITTALS:
A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Submit the following Shop Drawings, Product Data and Calculations:
   1. Manufacturer's model number of each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.
   2. For Steel Spring Mounts or Hangers: Free height, deflected height, solid height, isolator loading, and diameter of spring coil.
   3. For Neoprene Isolators: Free height, deflected height, and isolator loading.
   4. Dimensional and weight data for steel and rail bases, and details of isolator attachment.
   5. For Seismic Slack Cables: Indicate method to achieve vertical restraint.
   6. Provide seismic calculations to meet applicable codes for all mechanical equipment (isolated or non-isolated), piping and ductwork. Calculations shall be signed by an engineer registered in the State of Nevada with experience in the design of restraints for flexibly mounted equipment. Seismic restraint design and anchorage design are part of this certification requirement.

1.4 QUALITY ASSURANCE:
A. Provide seismic restraints on equipment as required by code as detailed on the Drawings. Include motors, AC's, control panels and exhaust fans. Installation of lateral and vertical restraining devices for ductwork and piping shall be in accordance with SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

PART 2 - PRODUCTS

2.1 MATERIALS:
A. General:
   1. Provide vibration isolators in accordance with the weight distribution to produce uniform deflection. Furnish deflections indicated.
   2. Where indicated, schedules, or specified, provide specific vibration isolation equipment, manufactured by Mason Industries, Inc., M.W. Sausse Co. (Vibrex). Where specific type of vibration isolation equipment is not shown or specified, furnish isolators.
recommended by the isolation manufacturer compatible with equipment arrangements shown. Provide products of single manufacturer for all vibration isolation equipment.

B. Isolators:
   1. General: Provide spring diameters no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid, equal to 50 percent of the rated deflection.
   2. Isolator Type 1, Neoprene Mounting: Double deflection neoprene mounting sized for a static deflection under load in the range of 0.25-0.5 inch. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Provide bolt holes for those areas where bolting is required. Isolators shall be Mason Type "ND", Vibrex Type "RD".
   3. Isolator Type 2, Freestanding Springs: Provide freestanding and laterally stable spring isolators without any housing and complete with 1/4-inch neoprene acoustical friction pads between the baseplate and the support. Provide all mountings with leveling bolts, rigidly bolted to the equipment. Isolators shall be Mason Type "SLF", Vibrex Type "RMS".
   4. Isolator Type 3: Housed spring mounting with limit stop. Springs in housings shall be as specified for Isolator Type 2. Provide housing with vertical resilient limit stops to prevent spring extension when weight is removed, as when equipment is drained. The housing shall serve as blocking during erection and the installed and operating to be the same. A minimum clearance of 1/4-inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be in contact during normal operation. Isolators used outside shall be hot dipped galvanized and springs neoprene coated. Isolators shall be Mason Type "SLR", Vibrex Type "RMLS".
   5. Isolator Type 4, Vibration Hanger: Vibration hanger to contain a steel spring and 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Provide spring diameters and hanger box lower hold sizes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hold and short circuiting the spring. Isolators shall be Mason Type "30N", Vibrex Type "HXA".
   6. Isolator Type 5, Vibration Hanger: Vibration hanger to contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to distribute the load on the neoprene and prevent its extrusion. Provide spring diameters and hanger box lower hold sizes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Provide hangers with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Hangers shall be Mason Type "@30", Vibrex Type "RMXA".
   7. Isolator Type 6, Vibration Hanger: Hanger to be a double deflection neoprene-in-shear, sized for a static deflection under loads of 0.25-0.35-inch. Isolators shall be Mason Type "HD" or "WHD", Vibrex Type "HSS".
   8. Isolator Type 7, Vibration Pad: Pad shall be neoprene at least 3/4" thick. Pad shall be Mason Type Super W, Vibrex.

C. Isolation of Piping Systems:
   1. Suspend all metal piping which connect to resiliently mounted equipment with resilient hangers or supported by floor mounted isolators within mechanical rooms. The first three supports from the connected machine to have the same static deflection as indicated for the machine. The remaining supports to have static deflection at least equal to one-half of the static deflection indicated for the machine mounting.
   2. Where static deflection in excess of 0.35 inches is required, floor isolators shall be Type 3 and isolation hangers shall be Type 4. Where deflection of less than 0.35 inches is required, floor isolators shall be Type 1 and isolation hangers to be Type 5.
D. Flexible Connections:
1. Use flexible neoprene connectors to prevent all piping to all isolated equipment, except equipment for this flexible connectors are not permitted by codes listed.
2. Connectors to be manufactured of multiple ply’s of nylon tire cord fabric and neoprene, both molded and cured in hydraulic presses. Use no steel wire or rings as pressure reinforcement. Connectors up to, and including, 2-inch diameter may have threaded ends. Connectors 2-1/2 inches and larger shall be manufactured with floating steel flanges. Rate connections to a minimum of 150 psi at 220 degrees F. Flanged equipment shall be directly connected to neoprene elbows in the size range 1-1/2 through 6 inches or any larger available size if the piping make a 90 degree turn at the equipment. Make all straight through connections with either flanged or screwed connectors pre-extended as recommended by the manufacturer to prevent additional elongation under pressure.
3. Drain connections from isolated equipment to floor drains shall have least 1-inch air gap above from drain.
4. Acoustical Sleeves: Where piping passes through equipment walls, floors or ceilings, provide a split seal consisting of two bolted pipe halves with 3/4-inch or thicker neoprene sponge bonded to the inner faces. Tighten the seal around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete shall be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Project the seals a minimum of 1-inch past either face of the wall. Where temperatures exceed 240 degrees F., 10 lb. density fiberglass shall be used in lieu of the sponge.

E. Isolation of Fractional Horsepower Equipment: Isolate all fractional horsepower fans, pumps, and equipment which are mounted on or suspended from floors that are not on-grade with neoprene-in-shear isolators as specified except where such isolators are furnished as an integral part of the machine.

F. Electrical Connections to Resiliently Mounted Equipment: Make electrical connections to equipment which is supported or suspended by vibration isolators with long lengths of flexible steel conduit or flexible armored cable. Locate these flexible connections so as to prevent rigid connections between the resiliently mounted equipment and the building structure.

G. Seismic Restraints:
1. Floor mounted equipment, piping and ductwork.
   a. Type S. Similar to Type 3 as specified in Paragraph 2.1 C., Isolators, designed for earthquake loads. Restraints shall be Mason Type SSLR or SSLFH, Vibrex Type "RMU-EQ-SH" or "RMLS-EQ".
   b. Type SL. All directional seismic restraints shall consist of interlocking steel members restrained by a one-piece molded bushing or bridge-bearing neoprene. Bushing shall be replaceable and shall have a minimum thickness of 1/4-inch. Incorporate a minimum air gap of 1/8-inch in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Provide removable snubber ends to allow inspection of internal clearances. Neoprene bushing shall be rotated to ensure no short circuits exist. Restraints shall be Mason, Type Z1225, Vibrex Type "3200".
2. Suspended equipment, piping and ductwork: Type SC, Seismic Slack Cables: Arrange cables to achieve the specified all-directional restraints, and sized to resist seismic loads. Install cables with sufficient slack to avoid short circuiting the vibration isolators. Restraints shall be Mason, Vibrex, Type Seismic Slack Cables.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install resilient hangers as near as possible to the supporting overhead structure. Locate the machine suspension points in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs is not allowed.

B. Attach suspension rods to rigid members of the machine structure. When such attachment points do not exist, furnish a heavy steel framework to support the machine with suspension rods attached to this framework.

3.2 FIELD QUALITY CONTROL

A. Ensure that all vibration isolators are installed in accordance with manufacturer's printed recommendations.

B. Replace, as approved by the Engineer, isolators which do not produce the required deflection, are inaccurately loaded above or below their correct operating height, or which do not produce the required isolation.

END OF SECTION
SECTION 15250
MECHANICAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Provide materials and accessories for the installation of mechanical insulation as indicated on the Drawings and as specified.

1.2 QUALITY ASSURANCE
A. All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E84, NFPA 255, and UL 723 not exceeding: Flamespread - 25; Smoke Developed - 50.
B. Accessories such as adhesives, mastics, cements, tapes and fiberglass cloth for fittings shall have the same component rating as listed above.
C. Insulation shall comply with Federal Specifications (FS) HH-I-552, HH-I-558, ASTM C547 and MIL-I-22344B.
D. All insulation shall have fire and smoke ratings as tested by Procedure ASTM E84, NFPA 225, and UL 723 and as required by UMC and shall not exceed a flamespread of 25 and a smoke development of 50.

1.3 SHOP DRAWINGS AND PRODUCT DATA
A. Submit the following items:
B. All insulation materials.
C. All jacket and facing materials.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect, and handle products to site under provisions of General Conditions and Division 1 as applicable.
B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
C. Store insulation in original wrapping and protect from weather and construction traffic.
D. Protect insulation against dirt, water, chemical, and mechanical damage.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Tape: Wherever tape is used for sealing purposes, provide a type as recommended by the nonconductive covering manufacturer. Where recommendation is lacking, seal the tape used with Minnesota Mining and Manufacturing Company adhesive EC-1329.
B. Insulating Cement: Insulating cement shall be Owens-Corning 110 mineral wool, all-purpose cement. Where insulating cement is applied to pipe fittings in concealed locations, provide a “one-coat” cement.

C. Pipe Insulation: Pipe insulation shall be multiservice-type suitable for all lines operating from 20° to 500° F. Insulation shall be one-piece consisting of glass fibers bonded with phenolic resin and molded into a hollow cylinder covered with a factory applied vapor barrier jacket.
   1. Thermal conductivity (Btu/hour square foot degrees F./inch) shall not exceed:
      a. At 75° F. mean temperature 0.22
      b. At 100° F. mean temperature 0.23
      c. At 200° F. mean temperature 0.25
   2. Vapor barrier jacket shall be heavy duty all service jacket (ASJ) consisting of laminated aluminum foil, glass reinforcing and white building paper. Perm rating shall be 0.01. Vapor barrier to form a vapor tight system.

D. Exterior Pipe Insulation Jackets: Provide aluminum jacket 0.016 inches thick, The Aluminum Association Type 3003 or 5005 alloys, with 3/16-inch longitudinal or circumferential corrugations. Provide jacket with factory-applied vapor barrier on the inside and apply using aluminum straps over transverse joints. Match corrugations from one section of cover to the other. On vertical runs the upper cover to lap over the lower cover and the seams shall be toward walls, horizontal seams shall be on the bottom of the run. Factory fabricate fitting and valve jackets of the same material as the pipe jacket. Seal all jacket joints and seams watertight.

E. Premolded Pipe Fitting Covers For Interior Use: Covers shall be factory-premolded one-piece polyvinyl chloride (PVC). Covers shall have a snow-white finish and shall withstand surface operating temperatures from 35 to 150 degrees F. continuous usage. All covers shall conform to Federal Specification L-P-535, Composition A, Type II, and shall be Ceel-Co. Series 100, Certainteed “snap-form,” Zeston.

F. Exterior Duct Insulation Coating: Provide elastomeric polymer-based vapor barrier and weatherproof coating. The vapor barrier coating shall be applied in a uniform pinhole-free coat to a minimum dry film thickness of 25 mils. The insulation shall be free of moisture, excessive rough texture, deteriorated surface, dirt, and debris. The coating shall be applied on the same day that the insulation is applied whenever possible. The coating shall be UL classified and meet NFPA standard 90A and National Fire Code 220(b). Coating shall be Childers - Encacel V, Marathon Industries Type 570.

G. Glass Fiber Semi-Rigid Board Insulation
   1. Glass fiber semi-rigid board insulation shall be 3 pounds per cubic foot semi-rigid board material of long glass fiber with resin binder. Thermal conductivity shall not exceed 0.24 Btu/hr square foot degrees F./IN at 75 degrees F. mean temperature. Insulation shall be applied to the inside of housing with 100 percent coverage of adhesive. Childers Products CP-88, Benjamin Foster 85-15, and mechanical fasteners recommended by the insulation manufacturer, spaced 12 inches on centers.
   2. Insulation shall be coated on one side with a neoprene compound to securely bond fibers against erosion in air stream.

H. Flexible Duct Insulation: Flexible duct insulation shall be adhered to the duct with Benjamin Foster 85-15, Childers Products CP-88, adhesive applied in 6-inch strips around the duct on 12-inch centers. Tying cord or twine shall be used to secure the insulation. Vapor barrier at butted joints shall be sealed with Minnesota Mining and Manufacturing Company, Childers Products, vapor barrier tape. Where insulation is furnished with vapor barrier flange, flanged joint shall be sealed with vapor barrier mastic.

I. Equipment Exteriors Requiring Vapor Barrier
   1. Glass fiber semi-rigid board insulation used where required in 15250-D. Use 3 pounds
per cubic foot material of long fiberglass with resin binder. Thermal conductivity shall not exceed 4 Btu/hr square foot degrees F./IN at 100 degrees F. mean temperature. Impale grooved and shaped boards on pins spaced 12 inches on center and securely fasten with self-locking metal caps swabbed with vapor barrier mastic, Owens-Corning, Childers Products.

2. All insulation edges and butt joints shall be sealed with Owens-Corning, Childers Products, pressure sealing tape. Insulation shall be faced with a vapor barrier jacket consisting of laminate of 0.001-inch aluminum foil and pre-sized glass cloth.

J. Premolded Pipe Fitting Covers: Interior used covers shall be factory-premolded one-piece polyvinyl chloride (PVC-FR). Covers shall have a snow-white finish and shall withstand surface operating temperatures from 35 to 150 degrees F. continuous usage. All covers shall conform to Federal Specification L-P-535, Composition A, Type II, and shall be Ceel-Co. Series 100, Certainteed “snap-form,” Zeston.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The insulation and materials shall be applied by mechanics skilled at such Work together with the required number of apprentices. The appearance of the finished Work shall be of equal importance with its mechanical correctness and efficiency. Insulation for heating surfaces and piping shall not be applied until such times as those surfaces have been heated to dry out the insulation. Insulation shall not be applied until the system is tested as required.

B. Wherever vapor barriers are specified, vapor seal all portions of the covering at joints and fittings.

C. Insulation shall be continuous through all walls, floors, and ceilings unless otherwise specified, or shown.

D. Where insulation is to be painted, prepare all surfaces to receive paint.

E. Insulate unions, flanges, and valve bodies but not operating handwheels or levers.

F. Application of all materials shall be in accordance with the manufacturer's printed instructions.

G. Handle the insulation in a manner that will not adversely affect its structural or insulating properties.

H. Provide support for the insulation on vertical lines to prevent the insulation from slipping downward.

I. Do not place insulation over vent and drain inlets and outlets.

J. Self sealing laps to have an additional field applied coat of adhesive applied to the opposite mating surface. Stapled insulation is not acceptable. The insulation longitudinal joints shall be in alignment away from view.

K. Seal all exposed insulation and joint openings in jackets.

L. Provide insert, not less than 12” long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2” diameter or larger, to prevent insulation from sagging at support points. Insert shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
M. Where pipe hanger rods penetrate vapor barrier, vapor barrier to be carried up and sealed around rod for a distance of 12 inches away from the outside of the pipe insulation.

N. Fittings and Valves

1. Hot Pipelines (above 60 degrees F.)
   a. Flanges, couplings, valves, anchors, and fittings shall be insulated with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation.
   b. When segments of insulation are used, provide elbows with not less than three segments. When nesting size sections of insulation are used, all voids shall be filled with insulating cement or mineral fiber. Secure sections of insulation in place with wire or by joining the sections with adhesive.
   c. Apply adhesive over the insulation in two coats with glass cloth or tape embedded between coats. Cloth or tape shall overlap itself 1 inch and adjoining insulation jacket 2 inches.
   d. Inserts to be installed in accordance with the fitting manufacturer's printed. Cover insulated flanges, couplings, valves, anchors, and fittings with preformed or field-fabricated sections of aluminum jacket secured with bands in lieu of finishes specified above.
   e. When pipe insulation with factory-applied aluminum jacket is provided, flanges, valves and fittings may be insulated with factory-or-field-fabricated sections of the same material and thickness as adjoining pipe insulation and jacket. Secure sections with bands. Unless otherwise shown, unions will not be insulated and pipe insulation and jacket shall terminate neatly at the ends of unions.
   f. Finish all termination points with a brush coat of adhesive.

2. Cold Pipelines (-30 to +60 degrees F.)
   a. Flanges, couplings, unions, valves, anchors and fittings unless otherwise shown insulate with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation.
   b. When nesting size sections of insulation are used, fill all voids with insulating cement or mineral fiber.
   c. Secure sections of insulation in place with wire or by joining the sections with adhesive.
   d. Apply vapor barrier coating over the insulation in two coats with glass tape or cloth embedded between coats. Overlap cloth or tape over itself 1 inch and adjoining insulation jacket 2 inches. Apply the coating to a total dry film thickness of not less than 1/16-inch. Insulate all flanges, couplings, unions, valves, anchors, and fittings with preformed or field-fabricated sections of aluminum jacket applied over the vapor barrier and secured bands. Where unions are shown to be not insulated, terminate the pipe insulation and jacket neatly at the ends of the unions. Seal ends of pipe insulation to the pipe with a brush coat of vapor barrier coating at termination points, valves, flanges, and fittings.

O. Insulation:

1. Pipe insulation shall be in accordance with Table 15250-A attached to the end of this Section.

2. Valves and Fitting Jackets
   a. Valves and fitting jackets shall be in accordance with Table 15250-B attached to the end of this Section.
   b. Cover strainers with an insulated base with a removable cover to permit cleaning of strainer screen when it is removed. Construct base of rigid insulation and vapor barrier equal to that specified for pipe.

3. Duct Insulation: Duct insulation to be in accordance with Table 15250-C attached at the end of this Section. Flexible ductwork shall be insulated similar to rigid ductwork.
4. Equipment Insulation: Equipment insulation shall be in accordance with Table 15250-D attached at the end of this Section.

5. All damaged insulation and damaged insulation jackets shall be removed and replaced with new insulation or jacket lengths to the approval of the Engineer.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEMP. RANGE</th>
<th>1 AND LESS IN.</th>
<th>1 ¼” TO 2 IN.</th>
<th>2 ½” TO 4 IN.</th>
<th>6 AND UP IN.</th>
<th>JACKET</th>
</tr>
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<tbody>
<tr>
<td>Hot/Tempered Water Domestic</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Hot/Tempered Water Return Domestic</td>
<td>90-200</td>
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<td>1.0</td>
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<td>--</td>
<td>All Service</td>
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<tr>
<td>Cold Water, Domestic, Non-Conditioned Areas</td>
<td>Any</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
<td>--</td>
<td>All Service</td>
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<tr>
<td>Condensate Drain</td>
<td>Any</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>--</td>
<td>All Service</td>
</tr>
<tr>
<td>Chilled and Heating Hot Water Service</td>
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<td>1.0</td>
<td>1.5</td>
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<td>All Service</td>
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<tr>
<td>Condenser Water (Exposed to weather only)</td>
<td>Any</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1.5</td>
<td>All Service</td>
</tr>
</tbody>
</table>

NOTE: All insulation exposed to weather and to view in mechanical rooms and air handling unit rooms shall be provided with aluminum covering.
### TABLE 15250-B
#### VALVE AND FITTING JACKET SCHEDULE

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>LOCATION</th>
<th>JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot/Tempered Water Domestic</td>
<td>All Concealed</td>
<td>Glass Cloth And Adhesive Or Premolded</td>
</tr>
<tr>
<td>Hot Water Heating</td>
<td>All Concealed</td>
<td>Glass Cloth And Adhesive Or Premolded</td>
</tr>
<tr>
<td>Hot/Tempered Water Domestic</td>
<td>All Exposed</td>
<td>Premolded Cover Interior Only</td>
</tr>
<tr>
<td>Cold Water Domestic</td>
<td>All Exposed</td>
<td>Premolded Cover Interior Only</td>
</tr>
<tr>
<td>Non-Conditioned Areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Handling Unit Condensate Drain</td>
<td>All</td>
<td>Premolded Cover Interior Only</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSTEM</td>
<td>LOCATION</td>
<td>JACKET</td>
</tr>
<tr>
<td>Piping</td>
<td>All Concealed</td>
<td>Glass Cloth And Vapor Cover</td>
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<td>Chilled Water and Equipment</td>
<td>All Exposed</td>
<td>Metal Jacket</td>
</tr>
<tr>
<td>Equipment</td>
<td>All Exposed</td>
<td>Metal Jacket</td>
</tr>
<tr>
<td>All Exterior Piping</td>
<td>All Exposed</td>
<td>Rigid Insulation with Full Metal Jacket</td>
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### TABLE 15250-C
#### DUCT INSULATION SCHEDULE

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>LOCATION</th>
<th>INSULATION</th>
<th>JACKET</th>
</tr>
</thead>
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<tr>
<td>Supply Air Heating &amp; Cooling</td>
<td>Concealed/Exterior</td>
<td>Glass Fiber</td>
<td>All Service Flexible</td>
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<td>Supply Air Heating &amp; Cooling</td>
<td>Exposed in Cooled &amp; Heated Space</td>
<td>Glass Fiber</td>
<td>Flexible Coating Per 2.1</td>
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<tr>
<td>Return Air Flexible</td>
<td>Concealed In Uncooled Or Unheated Space</td>
<td>Glass Fiber</td>
<td>All Service</td>
</tr>
<tr>
<td>Return Air</td>
<td>Concealed Or Uncooled Or Unheated Space</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Return Air Coating As Insulation</td>
<td>Exposed In Uncooled Or Unheated Space Or Mechanical Rooms</td>
<td>Glass Fiber Flexible</td>
<td>Per 2.1</td>
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<tr>
<td>Outside Air</td>
<td>All</td>
<td>Glass Fiber</td>
<td>Flexible Coating Per 2.1</td>
</tr>
</tbody>
</table>

**NOTE:** All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.
<table>
<thead>
<tr>
<th>Cooled Equipment</th>
<th>Insulation</th>
<th>Finish Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Conditioning</td>
<td>Glass Fiber-Coated</td>
<td>Glass Cloth With</td>
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<tr>
<td>Equipment Housings,</td>
<td>Semi-Rigid Board</td>
<td>Vapor Barrier</td>
</tr>
<tr>
<td>Interior</td>
<td>Insulation, 1 Inch</td>
<td></td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 GENERAL CONDITIONS AND SPECIAL CONDITIONS

A. Division 1 General Requirements of these specifications shall apply to the work in this section.

B. The Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said systems being made ready for operation in accordance with the requirements of NFPA, NFC, and the authorities having jurisdiction. The purpose of the Engineer specifications and drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission by Engineer of any necessary system component as required by the authorities having jurisdiction, in the specifications and drawings shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the Owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Designer/Builder and Engineer for clarification prior to the bid due date.

C. The Contractor shall provide all devices and equipment required by these specifications and drawings. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

1.2 PERFORMANCE GUIDELINES

A. Work provided under this section
   1. Site visit to determine existing conditions and extent of work.
   2. Review of project drawings to determine extent of work.
   3. Complete fire protection systems as outlined in these specifications, including all labor, materials and shop drawings needed to furnish and install a complete automatic sprinkler system, and all of the following:
      a. Siamese-type fire department connection with check valve and ball drip on the outside wall of the riser room or location approved by AHJ.
      b. Core drilling of floors and walls, and required firestopping. Patch as required.
      c. Wet pipe fire sprinkler systems, complete with supervised control valves, flow switch, drain piping and inspector’s test valve.
      d. Coordination of work with all other trades including coordination of sleeved holes in the main precast concrete floor beams.
      e. Shop drawings.
      f. Operating instructions and valve diagrams.
      g. As-built drawings.
      h. Waterflow and valve supervisory switches.
      i. Sleeves.
      j. Inserts.
      k. Cutting and patching.
      l. Cutting and patching required for new concealed piping installations in existing dropped ceiling areas. After completion of the work, ceilings shall match the existing ceilings in every respect. Only qualified workmen familiar with this type of work shall be employed.
1.3 SYSTEM ABBREVIATIONS AND DEFINITIONS

A. Approved: Unless otherwise stated, materials, equipment or submittals approved by the Engineer.


C. Architect: Tate Snyder Kimsey Architects


G. Concealed: Where used in connection with installation of piping or conduit and accessories, shall mean "hidden from sight" as in shafts, furred spaces, in soffits or above suspended ceilings.

H. Contractor: The company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers or fabricators.

I. CLVFR: City of Las Vegas Fire & Rescue.

J. DP: Dry pendent sprinkler.

K. EC: Extended coverage sprinkler.

L. ELO: Extra large orifice sprinkler.

M. Engineer: Schirmer Engineering Corporation (SEC).

N. Exposed: Where used in connection with installation of piping or conduit and accessories, shall mean "visible" or "not concealed”.

O. FDC: Fire department connection.

P. FM: Factory Mutual

Q. FM Approved: Materials or equipment approved by Factory Mutual and included in the most recent edition of the FM Approval Guide.


S. gpm: Gallons per minute.

T. Install: Install materials, mount and connect equipment or assemblies.


V. Owner: UNLV
W. PIV: Post indicating valve.
X. Provide: Furnish, install and connect.
Y. psi: Pounds per square inch.
Z. Remove: Remove material and equipment and restore surface.
AA. SFM State Fire Marshal.
BB. UL: Underwriters Laboratories, Inc.
CC. UL Listed: Materials or equipment listed by Underwriters Laboratories and included in the most recent edition of the UL Fire Protection Equipment Directory.

1.4 RELATED WORK

A. Materials and methods specified in other sections:
   1. Underground piping terminating in the fire riser room.
   2. Painting of sprinkler piping, hangers, and valves, including placing and removal of bags or other protection devices on sprinklers to prevent paint from touching any portion of a sprinkler.
   3. Painting of finished surfaces at pipe penetrations.
   4. Construction of new 1-hour rated riser room as indicated on the design drawings.
   5. Adequate heat for valve and riser rooms.

B. Materials furnished and installed in this section but wired by Others:
   1. Valve supervisory devices shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.
   2. Waterflow switches shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.

1.5 DESIGN CRITERIA

A. Sprinkler Systems:
   1. Provide a wet pipe sprinkler system with quick response, upright, pendent, and extended coverage sprinklers as indicated on the fire sprinkler contractor plans for complete protection of all areas with pipe sized per hydraulic calculations.
   2. All areas excluding outdoor covered walkways to be protected with wet pipe system. These are to be considered in the hydraulic calculations.
      a. Light Hazard density - 0.10 gpm per 1,500 ft² for class rooms, offices and assembly spaces.
      b. Ordinary Hazard, Group 1 density - 0.15 gpm per 1,500 ft² for kitchen and services area, mechanical room.
      c. Ordinary Hazard, Group 2 – 0.20 gpm per 1,500 ft² for storage areas, auto shop and wood shop.
   3. Any changes in design area, number of sprinklers operating, pipe schedule, pipe sizes, number of branch lines, number of mains or deviation from water supply as stated on the drawings shall necessitate complete hydraulic calculations by the Contractor and approval of changes by SEC prior to fabrication of pipe.
   4. Location of sprinkler head spacing shall be approved by the Architect before the start of construction.
   5. Contractor shall submit calculations along with the shop drawings.

B. Area Hydraulics
1. System designed per a waterflow tested conducted within 12 months of the submitted calculations. A flow test conducted by SEC is acceptable.

1.6 APPLICABLE STANDARDS

A. Reference Standards: The latest and enforced edition of the following standards are included as part of this specification:

1. National Fire Protection Association (NFPA):
   b. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

2. American National Standards Institute, Inc. (ANSI) Standards, current editions:
   b. A21.6 - Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids.
   c. A21.8 - Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds, for Water or Other Liquids.
   f. A21.51 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
   g. B16.1 - Cast-Iron Pipe Flanges and Flanged Fittings, 24, 125, 250, and 800 Pounds.
   h. B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
   i. B18.2.1 - Square and Hex Bolts and Screws.
   j. B18.2.2 - Square and Hex Nuts.
   k. B36.10 - Welded and Seamless Wrought Steel Pipe.

   a. A 53 - Standard for Welded and Seamless Steel Pipe.
   c. A 795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
   f. D1869 - Rubber Rings for Asbestos - Cement Pipe. (R 1972)

4. Factory Mutual Systems (FM) Publication:
   a. Approval Guide.

5. Underwriters Laboratories, Inc. (UL) Publication:

6. American Water Works Association (AWWA) Standards, current editions:
   a. B300-64 - Hypochlorites.
   c. C200-75 - Steel Water Pipe 6 Inches and Larger.
   e. C207-55 - Steel Pipe Flanges.
   f. C400-75 - Asbestos-Cement Pressure Pipe for Water and Other Liquids.
   g. C500-71 - Gate Valves - 3 through 48 inch - for Water and Other Liquids.

1.7 SUBMITTALS

A. Coordinate and attend a design development meeting with the Architect, precast concrete floor manufacturer, structural engineer, and Contractor to discuss precast beam sleeving locations.

B. Shop Drawings
1. Submit ten (10) copies of complete shop drawings and manufacturers’ data to the owner, SEC and FM Global for all necessary reviews prior to fabrication of materials.
2. Contractor shall submit complete system packages. Partial system submittals will be rejected.
3. When the plans are rejected because of incomplete or incorrect information, the Contractor shall be responsible for the Engineer’s extra review time and expenses beyond one resubmittal. Such extra fees shall be paid by the Contractor directly to the engineer when the resubmittal is made. The Contractor is not responsible for the engineer’s review time for the first submittal and first resubmittal, or for resubmittals required because of project changes.
4. The Engineer will return nine (9) prints to the Contractor, who shall then submit required prints to the Architect who shall review them and return seven (7) copies to the Contractor who will then submit to the SFM and CLVFR for final review and approval.
5. Hydraulic calculations shall include a water supply graph and hydraulic cover sheet. The cover sheet shall include the name and location of the calculated area, ceiling height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make, model, size, K factor and temperature rating, flow requirements, C factor used, water supply data and source of information.
6. Prepare shop drawings at minimum scale of 1/8" = 1'-0" for plans, and details. Show all piping, sprinklers, hangers, type of pipe, tube connections, outlets, and occupancy of each area, including ceiling and roof heights as required by NFPA 13.
7. Design shall be based upon fire protection bid drawings. However, it is the responsibility of the sprinkler contractor to visit the site and prepare working drawings as required.

C. Changes
1. Make no changes in installation from layout as shown on drawings unless change is specifically approved by the Engineer. This does not include minor revisions for the purpose of coordination.
2. Any changes made other than as stated above are at the Contractor’s own expense and responsibility.

D. Manufacturers’ Data
1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices which are provided or furnished involve work by another contractor, submit additional data copies directly to that Contractor.
   a. Sprinklers and escutcheons.
   b. Pipe, fittings and hangers.
   c. Control valves.
   d. Fireproof caulk.
   e. Waterflow devices.
   f. Valve supervisory devices.
   g. Bell.
   h. Horn.

E. As-Built Drawings
1. Maintain at the site an up-to-date marked set of as-built drawings which shall be corrected and delivered to the Engineer upon completion of work.
2. Upon completion, furnish the Engineer with five (5) sets of blueline prints, one (1) set of reproducible sepia prints, and one (1) set in electronic AutoCad 2007 “DWG” format of each reviewed shop drawing, revised to show “as-built” conditions.

F. Samples
1. Provide samples of each type of sprinkler covers and escutcheons.

G. Final Inspection and Test
1. The Contractor shall make arrangements with the Owner, Architect and Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect and the Engineer will witness the final inspection.
2. Perform all tests and inspections required by the referenced codes and standards, the SFM, CLVFR and the Owner.
3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be paid by the Contractor directly to the engineer prior to rescheduling the final acceptance tests.
4. The Contractor shall provide at least two (2) working days notice prior to all flushing, trip tests and hydrostatic tests. Testing will be scheduled to allow witnessing by the Owner.
5. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate.

H. Operating Instructions
1. Furnish five (5) copies of NFPA 25 and bound set(s) of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.

I. Spare Parts
1. Provide spare sprinkler cabinets, complete with sprinklers of assorted temperature ratings of the type necessary and in use throughout the installation. Each cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
2. Install sprinkler cabinet in each riser room.
3. Confer with the Owner's representative for exact location of cabinet

1.8 GUARANTEE
A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors’) work, materials, or equipment.

1.9 BASE BID, ALTERNATES AND ALLOWANCES
A. Base Bid
1. The base bid shall be in accordance with drawings and specifications.
2. The Contractor shall indicate the number of sprinklers included in the base bid.

B. Alternates
1. The Contractor shall state in his proposal any proposed contractor substitution of materials or methods of installation from that specified. These alternates shall be listed on the proposal as “Contractor Alternatives.”

C. Overtime Work
1. State in bid the extra amount to be charged for each hour of overtime work for each 
apprentice, fitter, foreman, supervisory person, etc., that might be working on this 
installation.
2. State the amount included in the base bid caused by anticipated overtime.
3. Overtime work must be authorized in writing by the Owner's representative.

1.10 PRODUCT DELIVERY

A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled 
to assure compliance with the predetermined construction schedules.
B. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of 
materials on job site, including furnishing of any storage facilities or structures required.
C. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of 
materials and equipment.

1.11 QUALITY ASSURANCE

A. Testing Agency: All material shall be UL listed or FM approved.
B. Regulatory Agencies: State and local building codes and ordinances, City of Las Vegas Fire & 
Rescue and the Owner requirements shall apply.
C. The Contractor shall be fully experienced and licensed in all aspects of the fire protection 
systems herein specified.
D. Similar materials shall be from a single manufacturer.

1.12 JOB CONDITIONS

A. Damage: Protect all unfinished work to prevent damage and furnish protection of all 
surrounding areas where necessary.
B. Leak Damage: The Contractor shall be responsible during the installation and testing periods of 
the sprinkler system for any damage to the work of others, to the building or its contents caused 
by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and 
shall pay for the necessary replacements or repairs to work of others damaged by such 
leakage. Water shall not be introduced into the system during conditions where there is danger 
of freezing.

1.13 EMERGENCY SERVICE

A. The Contractor shall provide emergency repair service for the sprinkler system within four hours 
of a request for such service by the Owner during the warranty period. This service shall be 
available on a 24-hour per day, seven-day per week basis.

1.14 TRAINING

A. The Contractor shall conduct two training sessions of four hours each to familiarize the facility 
personnel with the features, operation and maintenance of the sprinkler systems. Training 
sessions shall be scheduled by the Owner at a mutually agreeable time to the Contractor and 
the Owner.

1.15 PERMITS AND FEES

A. Obtain and pay for all permits, fees and charges required for this work.
PART 2 - PRODUCTS

2.1 GENERAL

A. All components shall be used in accordance with the manufacturers’ recommendations and its UL-listing and/or FM-approval.

B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.

C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.2 PIPE

A. Pipe shall be new, designed for 175 psi working pressure, conforming to ASTM specifications, and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.

1. Steel: Steel piping shall be galvanized, where exposed to atmosphere.
   a. Standard Wall: Overhead pipe used inside the buildings, shall be black steel and must comply with the specifications of the American Society for Testing and Materials, ASTM A 795 for black pipe, and hot dipped zinc coated galvanized welded and seamless steel pipe for fire protection use. Galvanized pipe shall be used where exposed to atmosphere. Dimensions for all overhead pipe must be in accordance with the American Standard for Wrought Steel and Wrought Iron Pipe ANSI B36.10-1975 for pressure up to 300 psi. Schedule 40 pipe is considered "standard wall" pipe. Schedule 30 pipe is acceptable in sizes 8-inch and larger. Pipe ends shall be welded, threaded or cut grooved.
   b. Light wall piping shall not be used.

2.3 FITTINGS

A. Changes of direction shall be accomplished by the use of fittings suitable for use in sprinkler systems and defined in NFPA 13. Bushings shall not be used.

1. Screwed fittings shall be cast iron, 125 pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 150 pound class, black and in accordance with ANSI B 16.3.

2. Flanged fittings shall be cast iron, short body, Class 125, black and in accordance with ANSI B 16.1. Gaskets shall be full-face of 1/8-inch minimum thickness red sheet rubber. Flange bolts shall be hexagon head machine bolts with heavy semi-finished hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B 18.2.


4. Push-end fittings shall not be used.

B. Grooved fittings, valves and pipe shall be joined using rubber gasketed couplings produced by the manufacturer of the fittings and/or valves. Gaskets shall be listed for use for the appropriate application (water or dry pipe system). Victaulic “Zero-flex” or equivalent. Rigid grooved
couplings shall be used where horizontal piping runs require more than two couplings per run. Rigid grooved couplings shall be used in standpipes (not in earthquake zones).

2.4 SPRINKLERS
A. Light hazard system areas will utilize quick response, ordinary temperature sprinklers.
B. The approximate number of sprinklers and types are shown on the drawings. If the number of sprinklers indicated in the sprinkler count summary differs from actual count on plans, the actual count shall be provided.
C. Install intermediate and high temperature sprinklers of proper degree rating wherever necessary to meet the requirements of NFPA 13.
D. Listed corrosion-proof sprinklers shall be installed in all areas exposed to corrosive conditions.
E. All sprinklers shall be both UL-listed and FM-approved.

2.5 OTHER COMPONENTS
A. Valves and Devices: All sprinkler control valves, devices, valves, etc., shall be approved or listed.
B. Signs
   1. Provide standard metal signs in accordance with NFPA 13.
   2. Provide hydraulic information sign(s) at riser(s) in accordance with NFPA 13.
C. Hangers
   1. All hanger components shall be of the approved and listed type.
   2. Below concrete construction, inserts, expansion cases or Phillips-type shells shall be installed to support the 1-inch through 4-inch size sprinkler piping.
   3. Below concrete construction, inserts shall be installed for all 5-inch, or larger piping, or, in lieu of the inserts, expansion cases, spaced not more than 10 feet apart may be installed in accordance with NFPA 13.
   4. Below steel deck and joist construction, use beam clamps to hang piping from top chord or joist. Do not hang piping from bottom chord, or bridging.
D. Earthquake Bracing Steel shapes listed in NFPA 13 shall be limited to maximum length indicated. When other shapes are provided, slenderness ratio shall not exceed 200 in accordance with NFPA 13. The Contractor shall submit calculations with shop drawings indicating least radius of gyration and maximum permissible length for each shape.

2.6 UNDERGROUND PIPING
A. All underground pipe and fittings shall be pressure centrifugally cast ductile iron enameline or cement lined mechanical joint, "Tyton" joint, or approved equal. Pipe shall conform to ANSI standards.

PART 3 - EXECUTION
3.1 INSTALLATION
A. General
   1. Clean-up
      a. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
b. At the completion of the work, remove all surplus materials, tools, etc., and leave the premises clean.

2. Safety
   a. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
   b. Contractor shall attend all job site safety meetings.

B. Fire Sprinkler Systems
   1. Overhead Piping
      a. All sprinkler piping, drain and test piping, fire department connection piping, etc.; exposed to weather shall be galvanized. All sprinkler piping must be substantially supported from building structure and only approved types of 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 or from steel angles supporting ductwork in accordance with NFPA 13.
      b. Sprinklers below ceilings which are on exposed piping shall be listed and approved regular bronze upright type, in upright position.
      c. Sprinkler piping shall be installed above drop ceilings except as noted otherwise. Install sprinkler piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.
      d. Install sprinklers as required by NFPA 13 with regard to ducts, obstructions and partitions.
      e. Complete sprinkler installation and place in service during nonworking hours in all areas where merchandise or fixtures are stored or in place.
      f. Provide sprinkler protection before combustible contents are moved into building.
      g. Install paired flanges and numbered test blanks to provide partial protection during construction. Maintain a "test blank log," as shown on drawing, at the site during construction to assure removal of all blanks at completion of job.

C. Drains
   1. Provide main drain valves at system control valves, sized in accordance with NFPA 13 and extend piping to the outdoors.
   2. Provide all auxiliary drains where necessary.
   3. Pipe all drains and auxiliary drains to locations where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel. Piping to roof drains is preferred. Drains may not outlet on walks but may outlet into planters or vehicular paving. Run drains below grade through curb faces where required to avoid outletting on walks. Provide concrete splash blocks where drains outlet into planters.
   4. Plugs used for auxiliary drains shall be brass.
   5. All piping and fittings downstream of drain valve shall be galvanized.
   6. High and low pressure drains shall not be connected together.

D. Electric Alarm Bells
   1. Provide one 110-volt 10-inch weatherproof outdoor electric alarm bell vane type D.P.D.T. waterflow switch arranged to activate for all systems.

E. Sleeves
   1. Set sleeves in place for all pipes passing through floor or wall openings.
   2. Space between sleeve and pipe shall be filled with noncombustible packing.
   3. Sleeves through floors shall be watertight.

F. Flushing Connections
G. Fire Department Connection
1. Install fire department connections properly connected to piping with necessary check valve and ball drip drain connection.
2. Provide standard nameplates marked “Standpipe” and “Automatic Sprinklers.”

H. Inside Control Valves
1. Provide OS&Y gate valves at the supply side of the wet pipe system manifold.
2. Provide post indicator valves.
3. Suction control valves for fire pump shall be indicating gate valve.
4. Submit complete manufacturer’s data, including type, number and sizes of control valves, to the Alarm Contractor.

I. Sprinkler Head Locations
1. Suspended acoustical tile ceilings: Sprinkler heads are to be at the center of ceiling tiles in the 2-foot, 0-inch direction and at the 3/4-inch point in the 4-foot, 0-inch direction so that the sprinkler head would be centered in a 2-foot by 2-foot half portion of the ceiling tile.
2. Contractor shall allow for adjustments to his sprinkler heads where aesthetic placement is a concern. Locations such as at special ceilings, light coves, lighting fixtures, etc., may require relocation and the addition of sprinkler heads.
3. Contractor shall review and consider the location and number of vents, duct utilities, framing members, etc., in design as well as construction of the sprinkler system. Extra changes will not be granted to the Contractor to adjust the sprinkler system to fit the build. Reasonable coordination requests are expected and will be reviewed by the Architect.

3.2 WELDING
A. No field welding of sprinkler piping shall be permitted.
B. Headers, risers, feed mains, cross-mains, and branch lines, may be shop welded using acceptable welding fittings. Welding methods shall comply with all the requirements of AWS D10.9, "Standard for Building Service Piping," Level AR-3. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler systems.
C. Provide a blind flange at each end of welded header.
D. Certify welders or braziers as being qualified for welding and/or brazing in accordance with the requirements of AWS D10.9, Level AR-3.

3.3 EARTHQUAKE PROTECTION
A. Provide listed flexible couplings in risers, feed mains and cross-mains, and approved sway bracing for risers, feed mains and cross-mains in accordance with NFPA 13.

3.4 INSPECTOR’S TEST
A. Provide inspector’s test connections, as specified in NFPA 13, at required points for testing each waterflow alarm device. Special discharge nozzle shall have same size orifice as smallest orifice sprinklers installed.
B. Provide 1-inch sight glass if inspector’s test discharge cannot be readily observed while operating valve.
C. Pipe all inspector’s test connections discharging to atmosphere to location where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.
D. Splash blocks shall be provided where inspector's test discharge could produce damage to surroundings.

E. All pipe and fittings downstream of inspector's test valve shall be galvanized.

F. Consult with Owner's Representative at job for exact location of inspector's test connections and discharge locators.

3.5 SPRINKLER GUARDS

A. Provide guards on sprinklers within seven (7) feet of finished floor or wherever sprinklers may be subject to mechanical damage, such as the gym areas and locker rooms.

3.6 SPECIALTY DEVICES

A. Installation of all specialty devices shall be in accordance with manufacturers' instructions. Where the installation of those devices require use of a torque wrench or other appliance, the Contractor shall certify that the manufacturers' instructions have been complied with.

3.7 UNDERGROUND PIPING

A. Clamp and thrust block all underground piping where required, in accordance with the requirements of NFPA 24 and local requirements.

3.8 EXCAVATION AND BACKFILLING

A. General

1. Perform all excavation, including necessary shoring, and all backfilling required for the completion of work under this contract that is to be installed underground, outside, or within building walls. The arrangement of shoring shall be such as to prevent any movement of the trench banks and consequent strain on the pipes.

2. Place all surplus dirt where directed by the Owner's Representative.

B. Excavation

1. Excavate to the required depth and grade to the bottom of the trench to secure the required slope.

2. Rock or concrete, where encountered, shall be excavated to a minimum depth of 6 inches below bottom of pipe.

3. Where mud, cinders or otherwise unstable or undesirable soil is encountered in the bottom of the trench, such soil shall be removed to firm bearing and the trench shall be backfilled with sand or bank run gravel to the proper grade and tamped to provide uniform firm support.

4. When water is encountered in the trench work, furnish and operate necessary approved pumping equipment and provide approved drainage facilities to keep excavation free of water.

5. The width of the trench at a point 1 foot above the top of the pipe shall not exceed four-thirds the outside diameter of the pipe, plus 8 inches.

6. Piping shall be buried to a depth with not less than 3 feet, 6 inches of cover.

C. Backfilling

1. The pipe joints shall remain exposed until the pipe has been tested by the Contractor and test witnessed by the Owner's representative(s) and any local authorities having jurisdiction thereof.

2. Remove all material used in shoring or trench banks before backfilling. Backfill consisting of sand or bank run gravel shall be placed to a depth of 1 foot above the top of the pipe and compacted by hand tamping. Backfill for the remainder of the trench shall consist of clean excavated material, free of rocks, stones or debris.
3. The Contractor shall be responsible for the entire work, but shall engage trades specializing in backfilling.

4. Submit certificates from a testing laboratory certifying that the backfilling and compaction thereof is in accordance with the requirements, before final pavement is installed.

END OF SECTION
SECTION 15410
PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work of this Section includes everything necessary and incidental to completing plumbing work, except as herein specifically excluded.

1.2 RELATED SECTIONS

A. Division 9 - Painting.
B. Section 15140- Pipe Supports and Anchors.
C. Section 15190 - Mechanical Identification.
D. Section 15240 - Vibration Isolation and Seismic Control.
E. Section 15250 - Mechanical Insulation.

1.3 REFERENCES

B. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
C. ASME B16.3 - Malleable Iron Threaded Fittings.
D. ASTM B32 - Solder Metal.
E. ASTM B88 - Seamless Copper Water Tube

1.4 SUBMITTALS FOR REVIEW

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
B. Product Data:  Provide data on pipe materials, pipe fittings, valves, and accessories.  Provide manufacturers catalog information.  Indicate valve data and ratings.

1.5 QUALITY ASSURANCE

A. Valves:  Manufacturer's name and pressure rating marked on valve body.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with UPC, ANSI/ASME B3.9.
1.7 DELIVERY STORAGE AND PROTECTION

A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 PIPING INSTALLATION

A. Description:
   1. Arranged as shown on the Drawings and as required for complete systems.

B. General:
   1. Unless otherwise specified herein, all equipment and fixtures shall be installed in accordance with the manufacturer's recommendations.
   2. Before submitting his bid for the work under this division the Contractor shall carefully study all Drawings and shall make a careful examination of the premises. He shall determine in advance, the methods of installing and connecting the apparatus, the means to be provided for getting the equipment into place and shall make himself thoroughly familiar with all the requirements of the Contract. After award of the Contract, no subsequent allowances will be made to the Contractor due to the failure to comply with the above requirements or any other conditions affecting the installation and completion of all work.
   3. All scaled and figured dimensions are approximate and are given for estimate purposes only. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, sizes, etc., of all equipment and materials to other parts of the equipment and to the structure.
   4. Any minor changes in work, which have not been installed, shall be made by Contractor without additional compensation except changes which increase or decrease the size of the materials specified or indicated on the Drawings. Contractor shall submit an estimate for the cost of, or credit for, such changes he does not consider of a minor nature and shall proceed only upon the written authority of the Owner.
   5. Piping shall be run straight and true to line free of traps, sags, and bends. Risers shall be plumb and form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, off-set only where necessary to follow walls or as directed.
   6. Locate groups of pipes parallel to each other with spacing to permit applying full thickness insulation and to permit access for servicing valves.
   7. All piping shall be concealed in walls or above ceilings (below roof) unless otherwise noted.
   8. Street elbows, bushings, and long screw fittings will not be allowed.
   9. All piping shall be isolated from other piping, any part of the building, framing, conduit, etc., with one inch (1") strips of hair, felt, or pipe isolators.
   10. Cleanouts, as specified (see plans for size), shall be no-hub and installed into pipe where shown on plans. Cleanouts shall be accessible in all cases and shall be brought to surface on "WYE" branches. All cleanouts shall be provided with removable floor or wall plate as herein specified.
11. Install stops on all hot and cold water fixture supplies, unless integral stops are specified. Supply trim shall have all metal-to-metal connections.
12. Install fuel gas piping in schedule 40 steel pipes unless otherwise noted.

2.2 DOMESTIC HOT AND COLD WATER PIPING SYSTEM

A. Mains, risers, branches, connections of sizes and arrangement as indicated on Drawings.
B. Shut-off valves shall be provided in main branches, runs to risers and where indicated on Drawings.
C. Metal piping below grade shall be wrapped with “Ten Mil” Polyethylene tape and jacket per ANSI/AWWA C105.
D. Joints under concrete slabs, if allowed by local codes, shall be brazed.

2.3 SOIL, WASTE AND VENT PIPING SYSTEMS

A. Sanitary System:
   1. Mains, risers, branches and connections of sizes and arrangement as indicated on Drawings.
   2. Schedule 40 PVC soil pipe and solvent-cemented drainage fittings below grade shall be in conformance with UPC/IAPMO Standards.
   3. Above grade piping and vent line in restrooms (only) shall be service weight cast iron with no-hub joints with stainless steel shielded no-hub couplings. Vent piping may be schedule 40 galvanized steel in lieu of cast iron pipe.
   4. Above grade piping and vent line in all other areas, shall be Propylene pipe, per section 2.4 “Laboratory Drainage” below.
   5. Cleanouts shall be provided where indicated on Drawings and in the following locations:
      a. Near bottom of each stack and riser.
      b. At every 90° change of direction for horizontal line.
      c. Every one hundred feet (100’) horizontal run.

B. Extend cleanout to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.
C. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connections with a complete venting system so gasses pass freely to atmosphere with no pressure for syphon condition on water seal.
D. Vent entire waste system to atmosphere. Discharge fourteen (14) inches above roof. Join lines together before projecting above roof. Offset vent line so they will not pierce roof near an edge or valley.
E. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange or coupling.
F. Grade all soil and waste lines at one quarter inch (1/4”) fall per foot minimum in direction of flow.

2.4 LABORATORY DRAINAGE (AW AND AV) SYSTEM:

A. Aboveground Laboratory Piping: Install polypropylene pipe with mechanical joints and/or electrical fusion joints per manufacturer's recommendations. Pipe material shall be UL, NSF, IAPMO listed and meet requirements of UL-94-VO(non-combustible/ flame retardant), Fire Marshall for fire spread/ smoke development rates, when installed above grade. Piping shall match existing approved materials.
2.5 VALVES
A. Provide shut-off valves where indicated and specified, and in following locations:
B. Risers and main branches at points of take-off from their supply or return mains.
C. Individual equipment units at inlet and outlet, to permit unit removal for repairs without interfering with remainder of system.
D. Locate valves for easy access and operation; where concealed, access doors shall be provided. Coordinate requirements with Prime Contractor.
E. Do not locate valves with stems below horizontal.

2.6 CONCEALED PIPING
A. Where so indicated or specified, conceal piping in building construction. Install such piping in time so as not to cause delay in work of other trades and to allow ample time for tests and approval; DO NOT COVER BEFORE TEST APPROVAL IS OBTAINED.
   1. Run up branches passing through floor into partition; offset above floor close to equipment unit; expose only as much as necessary for final connection.
   2. Where furred spaces are indicated, keep pipes close to structural members as possible so as to require minimum furring; in case of furred beams, obtain approval of resulting headroom clearance before installing pipes.

2.7 PIPES OVER ELECTRICAL EQUIPMENT
A. Do not run piping over electrical and IDF rooms and equipment.

2.8 CHECK FOR INTERFERENCES WITH OTHER TRADES
A. Before installing piping, check existing condition and architectural, structural, mechanical, electrical, and fire protection drawings as applicable. MAKE ACCURATE LAYOUT OF ALL PIPING, INCLUDING INSTALLED ELEVATIONS. Submit copies of final layout to other trades for checking and coordinating with their work so that grouped pipes, conduit, and ducts will not interfere with each other, or with full swing doors and will leave minimum headroom as indicated. Coordination of the plumbing piping is the responsibility of this section.
B. Protect Open Pipe Ends: Keep piping free from scale and dirt; protect open ends whenever work is suspended during construction to prevent foreign bodies entering and lodging there; use temporary plugs, or other approved material for protection.

2.9 EXPANSION JOINTS, ANCHORS, GUIDES AND SEISMIC RESTRAINT
A. General: Provide for taking up expansion in domestic hot water mains and risers by means of bends and offsets or expansion joints where indicated and/or required.
   1. Design of Loops, Bends, Offsets: As required, join bends only by welding only for steel pipes not for PVC, copper, or cast iron; submit design details for approval before fabrication.
   2. When installing piping with loop or bend expansion, subject it to cold springing, which will take care of about half of total expansion between cold and hot conditions.
   3. Branch connections shall have strain; "ON" when cold, "OFF" when hot.
   4. Make riser offsets in manner to avoid pocket forming due to expansion.
B. Anchors: Provide anchors for controlling direction and extent of pipe expansion at locations indicated on various piping layouts. Submit anchor details for approval prior to installation.
C. Seismic Restraint: All piping and equipment shall be suitably restrained and anchored in both horizontal and vertical directions to withstand seismic forces as required for the State of Nevada. See Architectural and Structural drawings for more information.

2.10 PIPE AND FITTING MATERIALS

A. Service Defined: Classification and names of services as used in "Schedule of Pipe and Fitting Materials" herein, shall have following meaning:
   1. Domestic Hot Water: Water between hot water heaters, storage tank, and plumbing fixture.
   2. Domestic Cold Water: Water between city water meter and plumbing fixtures and mechanical equipment make-up.

B. Waste: Sewer connection to plumbing fixtures and terminated in street mains or 5FT outside the Building.

C. Vent: Piping connection from plumbing fixture and terminated through roof to atmosphere.

D. Condensate: Drains from mechanical HVAC equipment and terminated in floor sinks or fixture tail piece.

E. Soil/ Waste Pipe: Any pipe which conveys the discharge of water closets, urinals, appliance or appurtenance in connection with plumbing system, or fixtures having similar functions, with or without the discharge from other fixtures, to the building drain or building sewer.

F. Fuel Pipe: Any pipe which carries combustible fuel gasses

G. Schedule: Unless otherwise specified, pipe and fitting materials shall conform to following schedule:
   1. Interpretation of Schedule: Figure "40" and "80" following pipe materials in this schedule designate pipe wall thickness, conforming to ASA B36.10, applicable to sizes 1" to 10" inclusive. Figure "40" shall mean "standard", "80" shall mean "extra strong" or "extra heavy", in the accepted trade terminology for pipe wall thickness.
   a. Fittings shall conform to pipe as to black, galvanized or C-P finish.
   b. Schedule of Pipe and Fitting Materials

<table>
<thead>
<tr>
<th>Pipe Pressure Service</th>
<th>Weight</th>
<th>Material for Joints</th>
<th>Type Fittings Material</th>
<th>Valve Rating PI, SWP</th>
<th>Shut off Valve Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Cold Water Below Ground Within the Building</td>
<td>Copper K Hard Drawn</td>
<td>AWSA5.8 BcuP Silver Braze</td>
<td>Cast Bronze/ Wrought Copper</td>
<td>600</td>
<td>Full Port Ball</td>
</tr>
<tr>
<td>Domestic Water Below Ground Under Concrete, Asphalt, Or turf Areas Outside of Building (2 ½&quot; and Smaller 3&quot; &amp; above)</td>
<td>Sch 80 PVC</td>
<td>Purple Primer/ Sch 80 PVC</td>
<td>600</td>
<td>Full Port Ball</td>
<td></td>
</tr>
<tr>
<td>Pipe Pressure Service</td>
<td>Weight</td>
<td>Material for Joints</td>
<td>Type Fittings Material</td>
<td>Valve Rating PI, SWP</td>
<td>Shut off Valve Type</td>
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<td>-----------------------</td>
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<td>------------------------</td>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Domestic Cold Water Above Ground</td>
<td>Copper L Hard Drawn</td>
<td>Non-Lead Soldered</td>
<td>Cast Bronze/ Wrought Copper</td>
<td>125</td>
<td>Full Port Ball</td>
</tr>
<tr>
<td>Domestic Hot Water Above Ground</td>
<td>Copper L Tube</td>
<td>Non-Lead Soldered</td>
<td>Cast Bronze/ Wrought Copper</td>
<td>125</td>
<td>Full Port Ball</td>
</tr>
<tr>
<td>Waste Above Ground-s sanitary</td>
<td>Service Weight Cast Iron</td>
<td>Cast Iron</td>
<td>No-Hub</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Vent-sanitary</td>
<td>Galvanized Steel Sch 40/ Cast Iron</td>
<td>Screwed Cast Iron</td>
<td>Wrought Cast Iron No-Hub</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Waste and Vent Above Ground-lab</td>
<td>Polypropylene Pipe</td>
<td>Mechanical/ Elec. Fusion</td>
<td>Mechanical Joints/electrical fusion joints</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Waste Below Ground Outside and Inside Building</td>
<td>Sch 40 PVC Solid Wall</td>
<td>Purple Primer/ PVC Glue</td>
<td>Sch 40 PVC/DWV</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Condensate</td>
<td>Cold drawn hot temper type L Wrought Copper</td>
<td>Soldered</td>
<td>Cast Bronze</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Fuel Gas</td>
<td>Sch 40 Black Steel</td>
<td>Welded</td>
<td>Malleable Iron or Forged Welding</td>
<td>150/175</td>
<td>Bronze Taper Plug valve Type crewed/Flange</td>
</tr>
</tbody>
</table>

2.11 ASTM DESIGNATIONS FOR PIPE AND FITTING MATERIALS

A. Pipe shall be stamped and manufactured in “U.S.” and shall conform to requirements covered by following ASTM Designations:
1. Steel 40 or 80: A-53, Grade B.
2. Copper Tube "K" and "L": B-88.
B. Fittings as specified in schedule for various services shall conform to requirements covered by the following ASTM Designations:

2.12 MANUFACTURERS OF PIPE AND FITTINGS

A. All pipe and fittings shall be "U.S." manufactured. Pipe manufacturer shall be submitted for approval. The following manufacturers will be acceptable for materials listed under each group.
   1. Steel Pipe
      a. U.S. Steel Co.
      b. Republic Steel.
   2. Copper Tubing and Fittings
      a. Muller Brass.
      b. Chase.
      c. Revere.
      d. Cerro.
   3. Cast Iron Pipe
      a. Alhambra.
      b. Anaheim Foundry.
      c. U.S. Pipe and Foundry.
      d. Universal Cast Iron Mfg.
   4. PVC Pipe: D1785
   5. Laboratory Waste and Vent Pipe
      a. Orion.
      b. Enfield Industrial Corp.

2.13 PIPE JOINTS

A. Unless otherwise specified, join pipe as follows:
   1. All steel pipe two inches (2") and smaller shall have screwed joints.
   2. Steel pipe two and one half inches (2-1/2") and larger shall have welded joints.
   3. All copper pipe shall have soldered joints made with 95-5 tin/antimony solder.
   5. Galvanized Vent Pipe: For above ground, 2" size and smaller only, with black cast iron drainage fittings.
   6. Dissimilar pipes (Copper To PVC): Make transition from PVC to copper at five feet outside the building (or beyond the concrete sidewalk) with schedule 80 T.O.E. Nipples for pipes 2" and smaller, and with PVC to copper flange with brass bolts and nuts for 2 ½" and larger. Wrap joints with "Ten Mil" Polyethylene tape and jacket per ANSI/AWWA C105.
   7. PVC pipe and glue fittings: PVC Purple Primer and PVC Solvent Type Glue.

B. Joints of Dissimilar Metals: Provide with isolation couplings or dielectric unions of same size as pipe. Where concealed in wall, provide access panel to dielectric unions.

C. Pipe Make-Up
   1. Pipe shall be carefully cleaned before installation. The ends of threaded pipe shall be reamed out fully size with a long taper reamer so as to be partially bell-mounted and perfectly smooth.
   2. All threads on black steel pipe shall be cut with new clean dies, full thickness of the die and so that no more than two (2) threads are left exposed on the pipe when the joint is made up in the fitting or valve.
3. Copper, brass pipe and chromed, polished or painted connections from fixtures shall show no tool marks. Make up with approved wrenches.
4. Thread lubricant/sealant shall be used for all threaded, joint make-up and shall be applied to the male threads only. Lubrication/sealant shall include threaded cleanout plugs.

2.14 PIPE SLEEVES, ESCUTCHEONS, COVERS

A. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, partitions, roof; provide one-piece escutcheons at exposed finished surfaces pierced by pipes.

B. Any pipe passing through a wall of a vertical shaft or through a wall of an occupancy separation or floor shall pass through a 16 gauge steel sleeve. After pipe has been installed through sleeve, remaining space shall be packed tightly with an rated inert packing (3” min. mineral wool) and sealed on both sides with an approved fire stop sealant; and secured each side of wall with an 16 ga. escutcheon around pipe. Submit shop drawings for approval.

2.15 SUPPORTS, HANGERS, INSERTS AND FLASHINGS

A. Pipe Support: All piping shall be supported in such a manner that it is securely attached to the structure of the building. Attachment is to be capable of supporting the tributary weight of pipe and contents in any direction. Maximum spacing of support and braces shall be as detailed in these specifications.

B. Support horizontal overhead piping with clevis hangers. Upper end of hanger rod shall be supported from an expansion anchor or similar code approved attachment. See Drawings for pipe support details. Submit shop drawings of all piping supports for approval.

2.16 VALVES TYPES

A. General: For valve location and installation, refer to "Valves" herein and the Drawings.

B. Valve Requirements: Unless otherwise indicated or specified for particular system or individual equipment unit, following requirements shall apply:
   1. Valves, General: Designed for packing under pressure with valve open or closed.
   2. Valves used for throttling of controlling flow: full port ball type as indicated.
   3. Full Port Ball valves on all cold tempered and hot water piping unless otherwise noted.
   4. Valves shall have rating of not less than 125 psi swp or as indicated in service schedule.
   5. Valve Material: Bronze for sizes three inches (3") and smaller.
   6. Valve Ends: Screwed for all sizes two inches (2") and smaller, except copper tube.
   7. Valve ends for Copper Tubes "K" and "L": Solder joint type.
   8. Check Valves: Horizontal swing type with bronze seat and composition or bronze disc as approved; body of same material, pressure rating, screwed or flanged, and finish, as adjoining globe or gate valves. Check valves in pump discharge lines of parallel pumps shall be of the spring loaded non-slam type as manufactured by "Mission" Duo Check Series 150-S-M-F. Submit shop drawings for approval.

2.17 ACCESS PANEL

A. Install where shown and over all concealed valves, cleanouts, isolation unions and any other concealed equipment which may require access for operation, maintenance and repair. Panel shall be sized for proper service not less than twelve inches (12") x twelve inches (12"). Submit Shop Drawings for approval.
PART 3 - EXECUTION

3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION

A. Potable and Industrial Water Piping:
   1. Run mains as indicated on the Drawings.
   2. Make allowance for expansion in the installation of all piping so that the usual variation in temperature will not cause stress at any point. Securely anchor where necessary to distribute expansion stresses.
   3. Arrange new system for complete drainage with 3/4 inch hose valves at low points.
   4. Anchor all lines and risers as necessary to prevent noise or vibration when water is turned on or off. Provide Water Hammer Arrestors as necessary.
   5. Separately valve each branch and riser. Make all such valves accessible with approved type panels.
   6. Where Drawings indicate fixtures as "N.I.C.," provide all rough-in stops; and supplies.
   7. Balance, vent and adjust piping to provide circulation to all fixtures and to prevent water hammer.
   8. Where indicated on the Drawings, valve, plug or cap pipe ends for future connection.

B. Sanitary Piping:
   1. Ream all pipe to full diameter after cutting and clean before erection. Run all piping as direct as possible, and conceal piping in finished rooms unless shown or specified otherwise.
   2. Install all horizontal sanitary drainage and vent piping of 3-inch diameter and less with a fall of not less than 1/4 inch per foot (2 percent). All horizontal sanitary drainage and vent piping larger than 3-inch may be installed with a fall of not less than 1/8 inch per foot (1 percent) if there is an acceptable justification (structural reasons, etc.) for such variation.

3.2 TESTS/FIELD QUALITY CONTROL

A. The following tests shall be made in the presence of the Owner and Architect. Forty-eight (48) hours notification shall be made prior to tests.

B. Potable Water and Industrial Water Piping Leakage Test:
   1. General: After completion of the Work, but before final, acceptance is made, run a test over a four hour period of time to prove that the capacity and performance of all apparatus fittings and the system as a whole meets the requirements of the specifications.
   2. Pressure Tests: Start and complete pressure tests in the presence of the Owner/Architect.
   3. Cold and hot water services within the Building shall be tested at 120 psi for a period of 4 hours. Any joints showing visible leakage shall be cut out and remade; pening of joints shall not be permitted. Retest sections of pipework containing remade joints.
   4. All underground water piping shall be tested to 150 psi pressure for three (3) hours. After tests, water pressure shall be left under supply main pressure for the balance of the construction period.

C. Sanitary and Lab Waste and Vent Piping Leakage Test
   1. Start and complete pressure tests in the presence of the Inspection Services.
   2. Test all waste drainage piping, including branch bends and ferrule joints, by closing all openings before any fixtures are set and filling the entire system with water, or by air pressure tests as specified below and approved by the Architect.
   3. Hydraulically test all underground piping at a minimum static head of 10 feet and to the top of the vent thru roof (VTR) pipes. Leakage at any point in the system shall be cause for rejection.
4. Test TEES shall be installed as necessary and as required for testing of all portions of new underground sanitary waste piping that are connected to the existing waste piping underground.

5. All aboveground piping shall be tested hydraulically by closing all openings in the piping system, except the highest opening above the roof, and by filling the system to the point of overflowing. In no case shall the pressure exerted on the system be less than 10 feet of head. Leakage at any joint shall be cause for rejection.

6. When it is impractical to test hydraulically, air test may be substituted for hydraulic testing. Forced air into the closed system at a uniform pressure to balance a column of mercury 20 inches in height or a pressure of 10 pounds per square inch gauge.

7. Under any of the previously described tests, the air or water pressure shall remain constant, after stabilization, for not less than fifteen (15) minutes without any further addition of air or water.

3.3 STERILIZATION

A. Perform sterilization of new piping prior to connection to the existing piping and distribution system.
   1. The lines and fixtures shall be flushed thoroughly prior to chlorination to remove dirt, etc. Screens on faucets to be removed during injection and replaced after completion of disinfection.
   2. Injection shall start only when all fixtures are connected up and ready for operation. All hot, tempered and cold water lines and fixtures to be done where required.
   3. A service cock or riser shall be provided by the Plumbing Contractor and located at the water service entrance. The disinfecting agent shall be injected into and through the system from these cocks or risers only.
   4. Chlorine, either gas or liquid, must be used as disinfecting agent. Calcium or Sodium Hypochlorite (liquid or powdered) - or as approved in Federal and AWWA procedures - may be used.
   5. The disinfecting agent shall be injected by a proportioning pump or device through the service cock or riser slowly and continuously at an even rate.
   6. All outlets must be fully opened at least twice during injection and the residual checked with orthotolidine solution.
   7. When the chlorine residual concentration indicates not less than 50 parts per million at all outlets, then all fixtures and water supply valves must be closed and secured.
   8. The residual shall be then retained for a period of not less than twenty-four (24) hours.
   9. After the retention, the residual upon checking at most outlets, shall not be less than ten (10) parts per million. If less, the disinfection must be repeated.
   10. If satisfactory, then all fixtures must be flushed until residual or orthotolidine tests shall not be greater than the incoming water supply.
   11. Upon completion of sterilization and flushing, Contractor to obtain a certification of analysis from a state of Nevada licensed laboratory and submit written copy to the Engineer and Inspector. The process shall be repeated if any samples prove unsafe.
   12. Perform above process for each phase of construction and prior to connecting of that phase to main water loop. Phasing may require multiple disinfection and sterilization process.

3.4 PRIOR TESTS

A. Concealed or insulated work shall remain uncovered until required tests have been completed.

3.5 BALANCE

A. Hot water return piping shall be balanced to ensure adequate hot water circulation, throughout branches if shown on the drawings. Lock balancing valve after balancing process is performed.

B. Refer to drawings for design flow through each hot water return branch.
3.6 WRITTEN REPORTS

A. Written reports, signed and approved by the Contractor's Project Inspector shall be submitted to the Owner to demonstrate compliance for all testing. Final pay request will not be released without submission of this report. No exceptions.

END OF SECTION
SECTION 15430
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. Provide all plumbing specialties as indicated on the Drawings and as specified. Supply fastenings, accessory features, and other items which are necessary to make a complete installation.

1.2 QUALITY ASSURANCE:


1.3 SUBMITTALS:

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Furnish Shop Drawings for all items.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Fixture Carriers
   1. Provide Zurn, J.R. Smith, Jonespec or equal fixture carriers.

B. Water Hammer Arrestors:
   1. Precision Plumbing Products (PPP, Inc.), J.R. Smith, Zurn, Fosam, Sioux Chief, Wilkins or equal. ASTM B 88, Type "K" hard drawn copper body, brass piston and threaded connector. Seal lubricant to be Federal Food and Drug Administration approved for use in potable water systems.

C. Cleanouts
   1. Concealed or Exposed in Unfinished Area: J.R. Smith Fig. 4291, Jonespec or equal.
   2. Finished Walls: J.R. Smith Fig. 4402, Jonespec or equal, with chrome plated top and satin finish.
   3. Finished Floors: J.R. Smith 4031-U-PB, Jonespec or equal, with chrome plated top and satin finish.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install per manufacturer’s instruction.

END OF SECTION
SECTION 15440
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION:
   A. Provide plumbing fixtures approved for water conservation and for handicap regulations.
   B. Provide all trim and appurtenances for proper operation and neat, finished appearance.
      Procure all rough-in data from manufacturer and rough-in and connect to fixtures as required.
   C. Refer to the Drawings for relocation of plumbing fixtures.

1.2 QUALITY ASSURANCE:
   A. Applicator (Erector) Qualifications: All equipment and accessories to be the product of a
      manufacturer regularly engaged in its manufacture. Supply all equipment and accessories new,
      free from defects. All items of a given type shall be the product of the same manufacturer.

1.3 REQUIREMENTS OF REGULATORY AGENCIES:
   A. In all cases where FS, CS, ANSI, NF, NSF or other standards are indicated or required,
      products shall meet or exceed the standards established for material, quality, manufacture, and
      performance.
   B. Fixtures and trim designated for the physically handicapped shall have prior approval of the
      applicable sections of the ADA Code prior to submissions of Shop Drawings and Product Data.
      The submission shall contain proof of the required State approvals.

1.4 REFERENCE STANDARDS:
   B. ASSE - American Society of Sanitary Engineers.
   C. CS - Commercial Standards, Commodity Standards Division, U.S. Department of Commerce.
   D. FS - Federal Supply Service, Standards Division, General Services Administration
   E. NSF - National Sanitation Foundation.

1.5 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. See Division 1 for requirements and include the following:
      1. Descriptive Data
         a. Plumbing fixtures.
         b. Plumbing fixture supplies.
         c. Fixture supports.
2. Shop Drawings
   a. Fixture backing.
   b. Rough-in Drawings.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

   A. Ship equipment in its original package, to prevent damage or entrance of foreign matter.
      Perform all handling and shipping in accordance with manufacturer’s recommendations.
      Provide protective coverings during conversation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

   A. Fixtures: American Standard, Kohler, Acorn, Bradley, Elkay or Just.

   B. Flush Valves: Sloan (Royal) or Zurn, Aqua-flush Z-6000.

   C. Seats
      1. Church
      2. Benecke
      3. Olsonite

   D. Supplies
      1. American Standard
      2. Kohler
      3. Crane

   E. Stops
      1. American Standard
      2. Kohler
      3. Crane

   F. Traps
      1. American Standard
      2. Kohler
      3. Crane

   G. Fixture Supports
      1. Zurn
      2. Smith
      3. Wade

   H. Drains
      1. Jonespec
      2. J.R. Smith or equal.

2.2 MATERIALS:

   A. Plumbing Fixtures Schedule
      1. General: Provide fixtures manufactured by Kohler, Acorn, Bradley American Standard,
         Eljer, Just or Elkay. See drawings for specifications.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Plumbing Fixtures:
1. Install fixtures as recommended by the fixture manufacturer except as shown differently on Drawings or where required by ADA.
2. Set fixtures level and equally spaced when installed in bank of more than two.
3. Rough-in supplies level, equally spaced and symmetrical with the fixture.
4. Rough-in wastes in alignment with the fixture drain. Off-setting trap and waste will not be acceptable. Install flush valves level with flush connections vertically. Offsetting and misalignment will not be acceptable.
5. Caulk with 100% mildew resistant silicone rubber sealant all deck mounted trim at the time of assembly, including fixture and casework mounted. Caulk all self-rimming sinks installed in casework. The butted space between fixtures and the wall, counter or floor on which they are mounted shall be sealed with white mildew resistant 100% silicone rubber caulking compound. See Division 7.
6. Point up fixtures at joints with walls and floors with non-hardening Tile-Fix.
7. Cover exposed fixture fastening nuts and bolts with china bolt caps. Fill with putty.
8. Make up trim with care and with the proper tools in order that no tool marks show after installation.

B. Water Supplies:
1. Provide each water supply to each fixture, equipment or faucet with a stop in the branch connecting thereto. The stop shall be a loose key stop at finished wall locations and a rough brass globe valve at rough locations. Angle stops for deck mounted faucets shall have an IPS inlet.
2. Cover unoccupied fixture faucet holes with chrome faucet hole covers.
3. Securely fasten screwed adaptor fittings behind water supply stubouts to the structure.

C. Waste Outlets: Bed strainers set in sanitary waste fixtures with glazing or plumbers putty.

D. Supports:
1. Support wall-hung sinks and lavatories by concealed chair carriers, commercial type, with block feet and thrust nuts. Securely anchor the carrier to the structure.
2. Bracket all other wall mounted fixtures to 12-gauge steel plates, fastened to face of steel studs, with metal screws, and with bracket screwed to backing.
3. Bolt chair carrier foot anchors and rear lugs to floor.
4. Add flushometer support arms that attach to wall.
5. Coordinate wall dimensions required.

3.2 ADJUSTMENT AND CLEANING:

A. In accordance with the requirements of Sections15050.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A Provide all labor, materials, equipment, tools, services and miscellaneous and incidental work to complete all plumbing equipment as indicated on the Drawings and as specified.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. American Society of Mechanical Engineers (ASME).
B. National Electrical Manufacturer's Association (NEMA).

1.3 SHOP DRAWINGS AND PRODUCT DATA SUBMITTALS

A. Furnish submittals including characteristic curves which show horsepower, capacity, and efficiency.
B. Furnish manufacturer's printed product data.

PART 2 - PRODUCTS

2.1 ELECTRICAL WATER COOLER (EWC)

A Electric water cooler as specified on the Drawings.

2.2 ELECTRICAL WATER HEATER (EWH)

A Electric water heater as specified on the Drawings.

2.3 EXPANSION TANK (DET)

A Closed, welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, 125 psi rating, cleaned, prime coated, with tapings for installation of accessories. Tank shall be precharged with heavy duty Butyl Rubber Diaphragm
B Manufacturers: Amtrol, Taco, Bell and Gossett.

2.4 DOMESTIC CIRCULATING PUMP (DCP)

A Domestic circulating pump as specified on Drawings.
B Manufacturers: Bell and Gossett, Grundfos, Armstrong.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with the manufacturer’s printed instructions

B. Provide valves at each piece of equipment to provide isolation of the equipment from its connected system.

3.2 WATER HEATER INSTALLATION

A. Install in accordance with manufacturer’s instructions and UL requirements.

B. Coordinate with plumbing piping and electrical work to achieve operating system.

END OF SECTION
SECTION 15480
LAB SPECIALTY SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials and equipment necessary for the complete installation of special piping systems within the Building as indicated on the Drawings and as specified.

B. Make all required rough-in and final connections for equipment specified in other Divisions.

1.2 SUBMITTALS

A. Shop Drawings and Product Data
   1. Furnish shop drawings and product data for the following:
      a) All systems and equipment specified in this Section.
      b) All pipe layout, including all valves, fittings and special items.
      c) Product Data: Submit manufacturer's catalog sheets and piping.
      d) Shop Drawings: Show arrangement of equipment, details of piping layout, floor and wall penetrations and electrical requirements for Work in Division 16.

B. Document of Compliance
   1. Submit to the Architect a document stating that welders are qualified to ASME, Section IV Code in 6-G positions. The welder's qualification test must closely duplicate actual field conditions at the Project Job Site, including the use of clean pipe fittings. The weldments will be inspected for contours on the root pass and for oxidation. Architect approved sample joints shall be stored at the Job Site for future reference.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Laboratory Oxygen & Carbon Dioxide (O2, CO2) system: These systems shall be piped from gas cylinders to outlets, as shown in drawings.
   1. Piping
      a. Type "L" pipe with brazed joints, completely prepared for oxygen service. All piping shall have all burrs removed and pipe ends shall be reamed and all chips removed. Before erection, all pipes, valves and fittings, except those supplied especially prepared for oxygen service by the manufacturer, shall be thoroughly cleaned in accordance with NFPA 99. Internal cleansing of systems after installation will not be permitted. Objectionable odors left by volatile agents and the effects of such agents on valves, seats and diaphragms, and resulting liquid accumulation in low spots of the system in use of water solutions of acoustics prohibit after installation cleansing. The system installation shall be made by certified technicians experienced in the installation of compressed (O2, CO2) systems. Technicians shall show evidence that they have a valid and current certification from a recognized testing laboratory qualified to verify brazing performance.
      b. Extend piping to all outlets as shown on the drawings. All piping shall have all burrs removed and pipe ends shall be reamed and all chips removed.
      c. Before erection, all pipe, pipe fittings, and valves shall be supplied, cleaned, prepared and sealed by the manufacturer, or company specializing in the preparation of piping for oxygen service.
d. All pipe, pipe fittings and valves not so furnished shall be cleaned and degreased by washing with a solution of trisodium phosphate and then thoroughly rinsed with water. Trisodium phosphate per gallon of water is prepared by mixing one-third of the total quantity of water with the total amount of trisodium phosphate required. When this has been dissolved the remaining water shall be added. The valves and fittings shall be immersed for five to fifteen minutes or until all deposits are removed. THE USE OF ORGANIC SOLVENTS, FOR EXAMPLE, CARBON TETRACHLORIDE, IS PROHIBITED. The system installation shall be made by certified technicians experienced in the installation of LAB gas(es) system. Technicians shall show evidence that they have a valid and current certification from a recognized testing laboratory qualified to verify brazing performance.

e. After installation of piping, but prior to attaching the equipment and before installation of the service outlet valves, the line shall be blown clear by means of nitrogen.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: All preparation shall be performed in the presence of the Architect.

B. O₂, CO₂ Systems
   1. Cleaning procedure shall be performed by the Contractor to assure the piping, fitting and valves are clean prior to being incorporated in the high purity process piping system.

3.2 TESTING

A. Procedure
   1. Check all systems and assure compliance with the Drawings and specifications. Check pressure and temperature rating of all valves to assure compliance with design standard.
   2. Check all safety valves for pressure settings. In the event adjustments and corrections are required to assure conformance with the Drawings, they shall be made prior to proceeding with the testing activity. Do not exceed pressure ratings of installed equipment.
   3. Test gages shall be installed and test medium source connections shall be made to convenient process connections. After completion of testing, the gages and sources connection shall be removed and the specified process attachments replaced as shown on the Drawings.
   4. Prior to testing operation, all valves shall be opened and all pipelines shall be blown out to remove all foreign matter. Lines may be purged out by progressively opening and closing valves.
   5. Test pressure shall be maintained until joints have been examined for leakage by means of leak test solution or other non-frothing solutions approved for this purpose.
   6. Test all piping as noted below until there are no leaks or loss in pressure. Repair or replace defective piping until tests are approved.
   7. Do not cover or enclose piping work before it has been tested, inspected and approved.

B. O₂, CO₂ Systems: All equipment, materials and installations shall be tested in the presence of the Architect. The Architect reserves the right to have any joint in the piping system which he suspects may be faulty, or as a part of a quality control program, to be cut out of the system by the Contractor for inspection and testing. Should the joint be sound, the Architect will reimburse the Contractor on a time and materials basis, as specified in the General Conditions of the Contract. Should the joint prove to be faulty or the adjacent piping found to be uncleaned or oxidized, or insufficient penetration (at least 95 percent for pipes under 1 inch and 85 percent for pipes 1-1/4-inches and larger) the destructive test will continue joint by joint until
sound joints are found. Replace the faulty work and materials. The pipes will be accepted only after a qualifying test showing that the quality of the gases at each of the valves is the same as in the inlet of the system.

C Qualifying tests shall be conducted in the presence of the Architect. The Contractor shall pay for testing.

END OF SECTION
SECTION 15510
HYDRONIC PIPING

PART 1 - GENERAL

1.1 WORK DESCRIPTION
A. Provide hydronic water piping for the air conditioning systems as indicated on the Drawings and as specified.

1.2 RELATED WORK
A. Section 09900 - Painting.
B. Section 15121 - Piping Expansion Compensation.
C. Section 15190 - Mechanical Identification.
D. Section 15240 - Vibration Isolation And Seismic Control.
E. Section 15250 - Mechanical Insulation.

1.3 REFERENCES
A. ASME B31.9 - Building Services Piping.
B. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
C. ASTM B88 - Seamless Copper Water Tube.
D. AWS D1.1 - Structural Welding Code.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Hydronic Water Piping
   1. Pipe: Schedule 40 black steel pipe ASTM A-53 Grade B.
   2. Fittings
      a. 2" and smaller: 150 psig. black malleable iron screwed fittings, ANSI B16.3.
      b. 2-1/2" and Larger: Standard weight seamless, carbon steel, standard radius butt welding fittings, ASTM A 106, Grade A or grooved and mechanical joint type.
      c. "Full Flow" fittings Style 07, or equal (no known equal).
   3. Unions: 150 psig. black malleable iron with brass to iron seating on piping 2" and smaller.
   4. Flanges
      a. 150 psig. Forged: Steel, slip-on or weld-neck, ANSI 816.5, ASTM A-181, Grade I, on piping 2-1/2" and larger.
      b. Flanges are not required on groove type joint fittings except for make-up to flanged valves or equipment.
      c. Gasket: 1/16" thick preformed neoprene bonded.
5. Copper Tubing: ASTM B88, Type L, hard drawn.
b. Joints: ASTMB32, solder, Grade 95TA.

B. Condensate Drains from Cooling Coils
1. Pipe:
   a. Seamless copper tubing, Type L, cold drawn, hard temper, ASTM B-88.
   b. Exposed to view at plumbing fixtures and finished equipment; satin finish CP brass pipe with threaded cast bronze fittings.

PART 3 -EXECUTION
3.1 INSTALLATION

A. Water Piping
1. Run piping as indicated on the Drawings.
2. Make allowance for expansion in the installation of all piping so that the usual variation in temperature will not cause undue stress at any point. Securing anchor pipes where necessary to properly distribute expansion stresses.
3. Use eccentric fittings for all changes in pipe sizes of supply and return lines arranged to prevent trapping of air, except where reducing tees are used.
4. Install flanged elbows for water connections to equipment with heat exchangers to allow easy removal of tube bundles. Place no obstruction in space required for tube removal.
5. Provide high points with air chambers and manual air vents with 1/4-inch copper tube vent line and stop cock carried to accessible point and away from pipe insulation.

B. Valves and Strainers
1. General: Unless shown otherwise provide valves at each piece of equipment to provide isolation of the equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers.
2. Unless shown otherwise, provide a check valve, and gate valve, in the discharge line and a strainer and gate valve in the suction line of each circulating pump.
3. Provide equipment with automatic control valves with ball or butterfly valves installed either ahead or behind the control valve, to permit removal of the control valve from the line without draining the system.
4. Provide “eccentric plug valves” for balancing valves.
5. Provide top level eccentric reducers on pump suction inlets.
6. Provide ball valve or butterfly valves for isolation.

C. Accessories
1. Pressure Gauges: Install pressure gauges across all pumps to indicate total pumping head. Gauges shall be of range required for pumping head and system static head. Install one gauge (each) at pump suction and discharge piping.
2. Provide the following where shown on the Drawings and where specified:
   a. Flow Indicators
   b. Thermometers
   c. In-line Flexible Pipe Isolators

3.2 FIELD QUALITY CONTROL

A. Piping System Leak Tests
1. Make pressure tests in the presence of the Owner/Architect.
2. Pressure test at 125 psig (860 kPa) or 150 percent of the operating pressure, whichever is greater. If found that any portion of the system does not function, make corrections as approved.

3. Perform all pressure tests with the use of a Bristol Recording Gage, and record of all tests kept for hand-over to the Owner.

B. Do not use pumps to support piping and fittings.

3.3 ADJUSTMENT AND CLEANING

A. Preparation of Water Systems for Balancing: Provide a Testing Agency to prepare the water systems for balancing in the following manner after completion of the air balance described hereinafter:

B. All normally open valves shall be in full open position.

C. Water in system shall be examined to determine if water has been treated and cleaned.

D. All screens in strainers shall be removed and cleaned. Flushing screens should be removed and set next to pumps.

E. Correct pump rotation shall be verified.

F. Expansion tanks shall be checked to determine they are not air bound and the system is completely full of water with no air pockets blocking water flow. Check all air vents to release air and ensure no air binding is present.

G. Proper operation of all automatic valves shall be verified.

H. Operating temperature of convectors shall be verified and set to design requirements.

END OF SECTION
SECTION 15535
REFRIGRANT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Filter-dryers.
E. Flexible connections.

1.2 RELATED SECTIONS
A. Section 09900 – Painting.
B. Section 15250 – Mechanical Insulation.
C. Section 15855 – Rooftop Air Handling Unit with Coils.
D. Division 16 – Wiring Devices & Supporting Devices

1.3 REFERENCES
A. ARI 495 – Refrigerant Liquid Receivers.
B. ARI 710 – Liquid Line Dryers.
D. ARI 750 – Thermostatic Refrigerant Expansion Valves.
E. ARI 760 – Solenoid Valves for Use with Volatile Refrigerants.
G. ASHRAE 34 – Number Designation of Refrigerants.
I. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
J. ASME B16.26 – Cast copper Alloy Fittings For Flared Copper Tubes.
K. ASME B31.5 – Refrigeration Piping.
L. ASME B31.9 – Building Services Piping.
M. ASME SEC 8D – Boilers and Pressure Vessels Code, Rules for Construction of Pressure
Vessels.

N. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, zinc-Coated, Welded and Seamless.

O. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

P. ASTM B88 – Seamless Copper Water Tube.

Q. ASTM B280 – Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.


S. AWS A5.8 – Brazing Filler Metal.

T. AWS D1.1 – Structural Welding Code, Steel.

U. MSS SP58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.

V. MSS SP69 – Pipe Hangers and Supports – Selection and Application.

W. MSS SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices.

X. UL 429 – Electrically Operated Valves.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardize. Provide necessary joining fittings. Ensure flanges, union and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with MSS SP69 unless indicated otherwise.

C. Liquid Indicators:
   1. Use line size liquid indicators in main liquid line leaving condenser.
   2. If receiver is provided, install in liquid line leaving receiver.
   3. Use line size on leaving side of liquid solenoid valves.

D. Permanent Filter-Dryers:
   1. Use in low temperature systems.
   2. Use in systems utilizing hermetic compressors.
   3. Use filter-dryers for each solenoid valve.

F. Flexible Connectors: Utilize at or near compressors or other vibrating/rotating equipment where piping configuration does not absorb vibration.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions and sizes.

C. Product Data: Provide general assembly of specialties, including manufacturer’s catalogue.
information. Provide manufacturers catalog data including load capacity.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

G. Manufacturer’s Installations: Indicate support, connection requirements and isolation for servicing.


1.6 PROJECT RECORD DOCUMENTS

A. Record exact locations of equipment and refrigeration accessories on record drawings.

1.7 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include instructions for changing cartridges, assembly views, and spare parts lists.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing the work of this section with minimum 3 years experience.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable State labor regulations.

C. Welder’s Certification: In accordance with ASME SEC 9.

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.11 MAINTENANCE MATERIALS

A. Provide two filter-dryer cartridges of each type.
PART 2 - PRODUCTS

2.1 PIPING

A. Copper Tubing: ASTM B280, Type ACR hard drawn.
   2. Joints: Braze, AWS A5.8 BCup silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

B. Pipe Supports and Anchors:
   1. Conform to MSS SP69.
   2. Hangers for Pipe Sizes ½ to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
   3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hangers rods.
   4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
   5. Vertical Support: Steel riser clamp, unistrut wall anchor.
   6. Floor Support: Steel clamp, unistrut, expansion anchor.
   7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
   8. Hanger Rods: Mild steel threaded both ends, threaded one end or continuous threaded.
   9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.2 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psig, and maximum temperature of 200 degrees F.

2.3 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 Inches long with copper tube ends; for maximum working pressure 400 psig.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer’s instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
E. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.

F. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

G. Pipe Hangers and Supports:
1. Install in accordance with MSS SP89.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Support vertical piping at every floor. Support riser piping independently or connected horizontal piping.
6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
7. Provide copper plated hangers and supports for copper piping.

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double as risers required. Slope horizontal piping 0.40 percent in direction of flow.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Provide access to concealed valves and fittings.

K. Flood piping system with nitrogen when brazing.

L. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.

M. Prepare unfinished pipe, fittings, supports and accessories ready for finish painting. Refer to Section 09900.

N. Insulate piping; refer to Section 15250.

O. Provide access to concealed valves and fittings.

P. Flood piping system with nitrogen when brazing.

Q. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.

R. Provide access to concealed valves and fittings.

S. Flood piping system with nitrogen when brazing.

T. Where pipe support members are welded to structural building frame, brush clean and apply one coat of zinc rich primer to welding.
U. Prepare unfinished pipe, fittings, supports and accessories ready for finish painting. Refer to Section 09900.

V. Insulate piping; refer to Section 15250.

W. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

X. Provide replaceable cartridge filter-dryers, with isolation valves and valve bypass.

Y. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

Z. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

AA. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

BB. Fully charge completed system with refrigerant after testing.

CC. Provide electrical connection to solenoid valves. Refer to Division 16.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

END OF SECTION
SECTION 15545
CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

1.1 WORK DESCRIPTION
   A. Cleaning of piping systems.
   B. Chemical treatment.

1.2 RELATED WORK
   A. Section 15510 – Hydronic Piping.

1.3 REFERENCES
   A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS:
   A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
   B. Submit product data indicating chemical treatment materials, and chemical.
   C. Submit manufacturer's installation instructions.
   D. Submit manufacturer's field reports.
   E. Submit reports indicating start-up of treatment systems is completed and operating properly.
   F. Submit reports indicating analysis of system water after cleaning and after treatment.
   G. Submit manufacturer's qualifications as outlined in 1.6.

1.5 OPERATION AND MAINTENANCE DATA
   A. Submit operation and maintenance data.
   B. Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs.
   C. Include step-by-step instructions on test procedures including target concentrations.

1.6 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years of experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.7 REGULATORY REQUIREMENTS
   A. Conform to EPA code for additional of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.
1.8 WARRANTY

A. Provide one (1) year manufacturer’s on-site warranty including parts and labor beyond substantial Completion of the Project.

1.9 MAINTENANCE, SERVICE AND EMERGENCY SERVICE

A. Submit reports of maintenance and emergency services to include descriptions of malfunctions and repairs or replacements made.

1.10 MAINTENANCE MATERIALS

A. Submit maintenance materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. System Cleaner
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products, sodium tripoly phosphate and sodium molybdate.
   2. Algaecide, chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.

B. Closed System Treatment (Water)
   1. Sequestering agent to reduce deposits and adjust pH, polyphosphate.
   2. Corrosion inhibitors, liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
   3. Conductivity enhancers, phosphates or phosphonates.

2.2 TEST EQUIPMENT

A. Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4 - 10 ml zeroing titrating burettes and associated reagents.

B. Provide the following test kits:
   1. Alkalinity titration test kit.
   2. Chloride titration test kit.
   3. Sulphite titration test kit.
   4. Total hardness titration test kit.
   5. Low phosphate test kit.
   6. Conductivity bridge, range 0 - 10,000 microhms.
   7. High nitrite test kit.

2.3 MANUFACTURERS/PROVIDERS

A. Chem Aqua. Inc.
B. Chem Treat, Inc.
C. Ondeo Nalco
D. Pacific Water Consultant
E. San Joaquin
PART 3 - EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

A. Heating Water System
   1. Add cleaner to closed systems at concentration as recommended by manufacturer.
   2. Apply heat while circulating, slowly raising temperature to 160° F. and maintain for 12 hours minimum. Remove heat and circulate to 100° F. or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.

B. Use neutralizer agents on recommendation of system cleaner supplier and approval of Owner.

C. Flush open systems with clean water for one hour minimum. Drain completely and refill.

D. Remove, clean, and replace strainer screens.

E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

3.4 CLOSED SYSTEM TREATMENT (HOT WATER)

A. Introduce closed system treatment through existing bypass (Pot) feeder when required or indicated by test.

END OF SECTION
SECTION 15750
HUMIDIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A All applicable requirements of other portions of the Contract Documents apply to the Work of this Section including, but not limited to, all Drawings, all Specifications, General Conditions, and General Requirements including submittals.

B Division-15 Section “Basic Mechanical Requirements” applies to work of this section.

1.2 DESCRIPTION OF WORK

A Extent of Evaporative Humidification System work required by this section is indicated on drawings, and by requirements of this section.

B Types of evaporative humidification system specified in this section include the following:
   1. High pressure water atomization type.
   2. All related components and accessories as indicated in these documents.

C Refer to Division-16 sections for the following work; not work of this section:
   1. Power supply wiring from power source to power connection on water pumps. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
   2. Interlock wiring between electrically-operated equipment and field-installed control devices.
      a. Interlock wiring specified as factory-installed is work of this section.

D Provide Control Wiring between field-installed humidity sensors or BAS output panel, solenoid valves and humidification system control panels, complying with requirements of Division-16.

E RO system piping.

1.3 QUALITY ASSURANCE

A Manufacturer’s Qualifications:
   1. Manufacturing company shall have five (5) years’ experience with application of the specified humidification system for HVAC Systems.
   2. Manufacturing company shall have field service support and local representation to provide continuing support of humidification system.

1.4 Codes and Standards:

A UL and NEMA Compliance: Provide electrical components required as part of humidifiers, which are listed and labeled by UL and comply with NEMA Standards.

B Provide electrical control panels assembled and labeled in UL qualified facility.

C NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of humidifiers.

D Uniform Mechanical Code and State Regulations and Rules.
1.5 SUBMITTALS

A Product Data: Submit manufacturer’s technical product data, including rated capacities of selected model clearly indicated, weights, installation and start-up instructions, and furnished specialties and accessories.

B Shop Drawings: Submit manufacturer’s assembly-type shop drawings indicating pipe routing, nozzle locations, solenoid valves, dimensions, weight loadings, required clearances, and methods of assembly of components.

C Wiring Diagrams: Submit manufacturer’s electrical requirements for power supply wiring to pump units, solenoid valves, sensors and control panels. Submit manufacturer’s ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D Maintenance Data: Submit maintenance data and parts lists for the entire system including pumps, sensors, valves, control and accessory: including “trouble-shooting” maintenance guide; product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Related Documents.

1.6 WARRANTY

A Provide one (1) year manufacturer’s warranty for replacement of defective parts and one (1) year contractor’s warranty for installation of replacement parts.

PART 2 - PRODUCTS

A. MATERIALS AND COMPONENTS

1. General: Except as otherwise indicated, provide packaged humidifiers and ancillary equipment with manufacturer’s standard materials and components as indicated and published product information, designed and constructed by manufacturer, and as required for complete installation.

2. Acceptable Manufacturers: Subject to compliance with requirements, provide the central evaporative humidification system manufactured by one of the following:
   a. Mee Industries,
   b. Approved equal.

B. HIGH PRESSURE WATER ATOMIZATION TYPE EVAPORATIVE HUMIDIFICATION SYSTEM

1. General: Provide high pressure water atomization type humidifier including the following components:
   a. Fog nozzles
   b. Fog pump unit(s)
   c. Water treatment equipment (using RO treated water).
   d. Fog nozzle manifolds and main feed lines.
   e. Droplet Filters and frames
   f. Electrical panels and automatic control valves.

2. The system component sizes and capacities shall meet the specified load for humidification zones.

3. High pressure humidification system shall not use more than .003 kW/# of moisture generated.

4. Humidification fog nozzles: Type 316 stainless steel body with 0.006 inch diameter low pressure drop nozzle orifice, and matching micro machined 304 stainless steel impaction pin shall be provided. Generating droplets of 17 micron (measured as Mass Median Diameter) at the operating pressure of 1,000 psi with integral filter (40 micron particle size) and fitting into nozzle adapters with o-ring seal (for hand tight installation).
5. High pressure water pump units: Complete fog pump units shall include the following:
   a. Pump unit operating capacity shall be 800 lbs/hr.
   b. Pump unit shall be full assembled and factory tested, and installed onto a stainless steel rack, with all components fully accessible for servicing.
   c. The pump unit shall be capable of minimum flow without overheating: the pump unit can be run down to a minimum flow of one fog nozzle (or even a closed discharge) without the need to bypass water back to an RO tank or dump water to drain in order to prevent overheating.
   d. Direct drive ceramic plunger pumps with stainless steel heads: Operating at not more than 700 rpm during full system gross load (320 lbs/hr).
   e. Pressure regulating valves: Stainless steel construction with stainless steel valve and valve seat.
   f. Electric motor shall be TEFC, premium efficiency model and includes motor overload protection.
   g. Pump unit shall include a VFD and pressure transducer to regulate the motor speed to match demand output.
   h. Pump unit shall include HOA and E-Stop switches.
   i. Pump unit shall include a PLC with touch screen HMI display panel. The PLC shall display the following data points:
      1) Master enable
      2) VFD speed
      3) Motor Current
      4) VFD Fault
      5) Pressure at pump inlet
      6) Pressure at pump discharge
      7) Pump run hours
      8) Hours since last oil change
      9) Hours since last seal change
   j. The pump unit shall display the following alarms:
      1) Low inlet water pressure
      2) High inlet water pressure
      3) High pressure filter differential (dirty high pressure filter)
      4) High pump discharge pressure
      5) Low pump discharge pressure
      6) Oil change required
      7) Seal change required
      8) E-Stop
      9) Master enable off
   k. Pump unit shall offer an optional plug in to allow the transmission of all of the above data points and alarms to the BMS.
   l. Pump inlet water filter (low pressure side), mounted on the front of the pump unit.
   m. Pump discharge water filter (high pressure side), mounted on the front of the pump unit.
   n. Pump unit shall include three pressure sensors connected to the PLC, which provide information for pump inlet pressure, pump outlet pressure and a differential pressure across the high-pressure filter.
   o. Pump unit shall include heat exchangers to maintain proper pump temperature during low output.
   p. Low pressure gauge, mounted on the front of the pump unit: liquid filled, for 0 to 60 psig.
   q. High pressure gauge, mounted on the front of the pump unit: liquid filled, for 0 to 2,000 psi.
   r. Fitting and hoses: low-pressure side fittings shall be stainless steel construction. High-pressure side fittings shall be of 304/316 stainless steel. Low-pressure inlet hoses and high-pressure discharge hoses shall be provided as part of humidification system.
s. All wetted parts including piping shall be non-corrosive (stainless steel).
t. Pump unit shall include an electrical disconnect.

6. Fog Nozzle Manifolds and Main Feed Lines:
   a. All nozzle manifold and main lines shall be stainless steel tubes (ASTM A-269, 
      ½” outside diameter, 0.035 inch thick, welded wall).
   b. All fittings shall be double-ferrule type compression fittings of type 316 stainless 
      steel tubes.

7. Droplet Filters and Frames: Filters shall be UL Class I rated, polymer based with 
   biocide agent. Filters shall be rated for use up to 750 fpm. Filters shall be installed in a 
   stainless steel frame.

8. Zone control valves: High pressure zone control valve(s) shall be provided on the water 
   supply line to each humidification zone to stage the humidification process at the fog 
   nozzles. The valves shall be rated for 1,500 psi operating pressure with stainless steel 
   wetted parts.

9. Valve Control Panels: Shall include the following:
   a. On-Off-Auto switches for each solenoid valve.
   b. Relay for each valve to be controlled by BMS via dry contact closures.
   c. Valve Control Panel shall enable fog pump when humidity demand signal is 
      present.
   d. Humidity sensors-controllers by BAS.

10. Water Treatment: As follows.
    C Reverse osmosis (RO) water treatment system will be provided as part of humidification 
    system. The RO treated water shall be piped to the fog pump units for this central 
    humidification system as part of this humidification work.
    1. The system supplier shall conduct complete water analysis on the RO treated water 
       and make recommendation for water treatment additionally required prior to 
       commencing work.
    2. Water treatment system shall protect against:
       a. Excessive plugging of nozzles, not more than 10% per year.
       b. Any water condition that could cause excessive wear or damage to the fog 
          nozzles.
       c. Any dangerous bacteria growth or any condition that could result in dangerous 
          bacteria growth, and
       d. Any possibility of “dusting” of the air with mineral salts.
    D. RO Piping: RO system from the mechanical room to air handling unit on roof shall be piped in 
       fully annealed, seamless, stainless steel tubing ASTM A-213 type TP-316 with a hardness not 
       to exceed Rb 90. Tubing shall be free of scratches.
       1. Wall thickness shall be not less than:
          | Tubing Size | Wall Thickness |
          | 1/2         | .065          |
       2. Fittings shall be Swagelok or approved equal, double ferrule tube fittings.
       3. All tubing and fittings shall be factory cleaned and sealed.
       4. For piping materials between the different components of the Humidification system 
          refer to spec and drawings.

PART 3 - EXECUTION

3.1 INSPECTION

A Examine areas and conditions under which humidifiers are to be installed. Do not proceed with 
work until unsatisfactory conditions have been corrected.
3.2 INSTALLATION OF HUMIDIFICATION SYSTEM

A. General: Installation shall be performed or supervised by the humidification system manufacturers factory trained representative.

B. The system shall be installed in accordance with system manufacturer’s written instructions, and with recognized industry practices, to ensure that humidification system comply with requirements and serve intended purposes.

C. Access: Provide access space around humidification system components for service as shown in drawings, but in no case less than that recommended by manufacturer.

D. Support: Provide supports from substrate for humidification system components in accordance with manufacturer’s installation instructions.

E. Electrical Wiring: Install electrical devices furnished by manufacturer, but not specified to be factory-mounted. Furnish copy of manufacturer’s wiring diagram submittal to the electrical wiring installer.
   1. Verify that electrical wiring installation is in accordance with manufacturer’s submittal and installation requirements of division 16 Specification. Do not proceed with equipment start-up until wiring installation is acceptable.

F. Connect and run necessary drain piping into floor sink.

G. Grounding: Provide electrical equipment ground for electrical-operated humidification system components.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that air humidification equipment is leak-tight.

B. Repair or replace air humidification equipment as required to eliminate leaks, and retest as specified to demonstrate compliance.

3.4 START-UP, ADJUSTING AND CLEANING

A. Start-Up: Start-up humidifiers in accordance with manufacturer’s instructions under supervision of manufacturer’s local representative.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer’s touch-up paint.

3.5 INSTALLATION OF “RO” PIPING

A. All joints in the tubing, except those at valves or equipment requiring screwed connections, shall be made of Swagelok fittings. Suitable adapters shall be used for installation of valves and other equipment provided with threaded connections.

B. Screwed joints made for attaching vales or other permanently connected equipment shall be installed by tinning the male thread with soft solder before assembly. The tinning must provide thorough coverage of the threads and the joint must be taken up a sufficient number of turns to provide normal thread engagement. Where heating is required to effect proper assembly, adequate precautions must be taken to avoid damage to the valve or equipment to overheating. Do not use any compound such as pipe dope, shite lead, etc., on screwed joints. Teflon tape shall be used.
3.6. CLEANING OF RO PIPING

A. RO systems are high purity systems. Cleaning shall be necessary to obtain the required water quality. Piping, fittings and valves shall be factory cleaned to standards required for pure water type piping and shall be sealed before shipment from the factory.

B. Before erection, all tubing, valves and fittings shall be thoroughly cleansed of oil, grease, dirt or other contaminating materials by washing in a hot solution of sodium carbonate or trisodium phosphate mixing the proportions of 1 pound to 3 gallons of water. Scrubbing shall be employed where necessary to obtain complete cleaning. After cleaning all tubing, fittings, and valves shall be plugged or wrapped during storage and transported to the location site. Particular care must be exercised in the handling of all material and conditions of tools used in cutting or reaming to prevent oil and grease being introduced into the pipe, tube, or fitting. Where such contamination has occurred, the items affected must be rewashed.

3.7. TESTING OF RO PIPING

A. All piping shall be tested. Piping shall be tested for systems of maximum purity. The Contractor shall employ preliminary pressure tests outlined below.

B. After erection of the tubing, but before installation of outlet valves, the line shall be blown clear by means of dry air.

C. After installation of outlet valves, each section shall be subject to a test pressure of at least 1-1/2 times the maximum working pressure, but not less than 80 pounds per square inch by means of dry air. This test pressure shall be maintained until each joint has been examined for leakage.

END OF SECTION
SECTION 15855
ROOFTOP AIR HANDLING UNIT WITH COILS

PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Custom air handling units in accordance with the equipment schedules and specifications.

1.2 RELATED WORK
   A. Section 15170 - Motor and Variable Frequency Drives
   B. Section 15535 - Refrigerant Piping And Specialties
   C. Section 15750 - Humidification System
   D. Section 15885 - Air Cleaning

1.3 REFERENCES
   A. AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
   B. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings.
   F. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices.
   I. ARI 435 – Application of Central-Station Air-Handling Units.
   J. NEMA MG1 – Motors and Generators.
   K. NFPA 70 – National Electrical Code.
   L. SMACNA – HVAC Duct Construction Standards - Metal and Flexible.
   M. UL 900 – Test Performance of Air Filter Units.
   N. ANSI/AMCA Standard 210-99, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating"
   O. AMBA Method of Evaluating Load Ratings of Bearings ANSI-11 (r1999)
   P. AMCA Publication 211-05, "Certified Ratings Program - Product Rating Manual for Fan Air Performance"
Q. ANSI Z9.5 - Laboratory Design
R. ASHRAE - Laboratory Design Guide

1.4 SUBMITTALS

A. Submit shop drawings and product data as applicable.
   1. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required
      clearances, construction details, field connection details, and electrical characteristics
      and connection requirements.
   2. Product Data
      a. Provide literature that indicates dimensions, capacities, ratings, performances,
         gauges and finishes of materials, and electrical characteristics and connection
         requirements.
      b. Provide data of filter media, performance, framing and assembly.
      c. Provide fan curves with specified operating point clearly plotted.
      d. Provide coil selection with performance data
      e. Provide pressure drop calculation report indication the internal pressure loss
         and available external loss.
      f. Submit sound power level data for fan outlet, fan inlet and casing radiation at
         rated capacity.
      g. Submit electrical requirements for power supply wiring including wiring
         diagrams for interlock and control wiring, clearly indicating factory-installed and
         field-installed wiring.
      h. Submit performance, noise and vibration test results of the air handling unit as
         required by specifications. Provide test results for review prior to any air
         handling unit shipment to the job site.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit installation, startup, operation and maintenance data.
   1. Maintenance Data: Include instructions for lubrication, filter replacement, motor and
      drive replacement, spare parts lists, and wiring diagrams.
   2. Include manufacturer's installation instructions.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section
   who issues complete catalog data on total product.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of General Conditions and
   Division 1 as applicable.

B. Accept products on site in factory-fabricated protective containers, with factory-installed
   shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to
   avoid damage to components, enclosures, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters
   are in place and fan has been test run under observation.

1.9 QUALITY ASSURANCE
A. Conform to space and access requirements; units which do not conform to space and access requirements will not be accepted.

B. Direct expansion coils shall be designed and tested in accordance with ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration.

C. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Alliance Air Products

B. Themtrol

C. Governair

2.2 FABRICATION

A. Unit Base: Perimeter of unit base shall be constructed from ASTM A36 structural steel ‘C’ channel. Internal supports shall consist of structural rectangular tubing on minimum 24” centers. All fans and coils shall be supported on minimum ¼” thick structural tubular steel. The unit base shall be fully welded. Height and section of structural members shall take into account internal loading, unit height, length and width, and split sections so as to limit base deflection to 1/200 of span. Curb mounted units shall be provided with curb angle welded on inside of structural base.

1. Prior to welding, all structural ‘C’ channels shall be sandblasted to remove rust and mill scale. Wire brushing or chemical treatment is not acceptable.

2. Heavy removable lifting lugs shall be added to the perimeter channel along the longest length of the unit. Removable type lifting lugs shall be provided with welded attachments. Provide a minimum of 4 lugs per section to ensure proper rigging.

3. Unit floor shall be covered with 16 gauge bright galvanized sheets as standard. The floor shall be supported by stringers and structural members on maximum 24” centers. All seams shall be supported underneath by structural supports. Floor shall be attached to base structure by welding from underneath on maximum 6” centers. Floor seams shall consist of minimum 1” standing seams, caulked and covered with cleats to ensure water and air tightness. Penetrations through unit floor are not acceptable.

4. Isolator supports shall be attached to base structural members with minimum 3/8” Grade 5 bolts. Welding to the floor skin is not acceptable.

5. Coil drain pans shall be supported by structural steel members under the floor.

B. Unit Housing: The unit housing side and roof panels shall be constructed of 16 gauge galvanized steel, and shall utilize a standing seam modular panel type construction. The panels shall be attached to each other, to the roof, and to the floor using bolts so that all panels are removable. All seams shall be sealed with a high strength polyurethane sealant prior to assembling the panels. After assembly, exterior panel seams shall be filled with acrylic latex caulk for appearance. Bolting shall be zinc plated ¼-20 on maximum 8” centers. Sheet metal or ‘Tek’ fasteners are not acceptable for sealing pressure containing panels.

1. Fan sections shall include 20 gauge perforated galvanized interior sheet metal liners in fan blast area.

2. Cooling coil and direct evaporative sections shall include 20 gauge 304 stainless steel liner.

3. Insulation in sections lined with perforated sheets shall be faced with neoprene.

4. All floor openings shall have 1” minimum flange up around entire perimeter.
5. Roof shall be sloped at ¼” per foot for all exterior units. Slope must be maintained after installation.

6. Access doors shall be provided full height (72") where unit height permits, and shall be 24" wide where section length permits, otherwise minimum of 18” shall be used. Doors shall be 2” thick, double wall and insulated type. Exterior door panels shall be constructed from painted A60 galvanized steel; interior panels are bright galvanized G60 steel. Door insulation shall be injected urethane foam with a minimum R value of 13-Ft2-°F/BTU. Door frames shall be heavy aluminum extrusion with one-piece, closed cell, replaceable santoprene gasket seal.

7. Door hinges shall be die-cast zinc with provision for adjustment without the use of shims or special tools. Door latches and handles are to be bolted to the unit and made with corrosion resistant materials. Bolts, nuts and shafts for door latches, handles and hinges shall be made of zinc plated steel. Door latch and pawl assembly shall be industrial quality and corrosion resistant with a handle on both the inside and outside of door. Latching mechanism shall be of conical roller design. Latch and pawl assembly shall be bolted together without the use of set screws allowed.

8. All doors to fan sections shall be provided with latches which require a tool to open.

9. Viewing windows shall have double thermal pane wire reinforced safety glass.

C Piping Cabinet Section: Piping Cabinet Section shall be constructed per paragraph B above, “Unit Housing” and shall be made with Minimum depth of 30” and full coil section width to allow appropriate access to all coil connections, installation of valves and accessories, etc.

D Insulation: Wall and ceiling panels shall be insulated with 2”-1.5#/cu.ft. fiberglass insulation. Insulation under solid lining shall be unfaced; otherwise, insulation shall be faced with an acrylic or neoprene coating. Insulation shall be tested and rated per ASTM C 423 and NFPA-90a rated. Insulation shall have thermal conductivity K factor of .24 Btu/Hr/Sq Ft/Degree F @ 75degree F mean and the following sound attenuation characteristics:

E Insulation under floor shall be sprayed urethane foam with a minimum thickness of 2” and a minimum aged R value of 11.5 Hr-Ft2-°F/BTU.

F Paint Finish: Exterior wall and roof panels shall be coated with air dry acrylic polyurethane to a minimum dry thickness of 3 mils. Finish shall have no blistering or rusting on unscribed areas after 2,000 hours in accordance with ASTM B-117 salt fog test. Entire structural steel base shall be primer painted with industrial grade epoxy primer for total thickness of 4 mils minimum.

G Fans:
1. Plenum Fan Assembly: Fan shall be SWSI arrangement 3 (Direct drive arrangement 4 is acceptable) as indicated on the schedule. Shaft shall be sized not to exceed 75% of the first critical speed at the maximum speed for the fan class. Fan frame and base shall be constructed of welded structural steel angle, and painted with 3 mils of industrial grade water-based air dry enamel. Bearings shall be cast iron pillow block mounted self-aligning ball or roller type. Bearings shall be rated for a minimum average life of 200,000 hours at the maximum horsepower and speed ratings for the fan class. Fan wheel and sheaves shall be keyed to the fan shaft. Each fan assembly, including sheaves and belts, shall be trim balanced at the factory in accordance with ANSI 204-96 to Balance Quality Grade G6.3. Fans shall be rated in accordance with AMCA Standard 210 for air performance and AMCA 300 for sound. All fans shall carry the AMCA certification label.

2. Motors and Drive: Furnish premium-efficiency open drip proof, NEMA frame, ball bearing type motors. Motor horsepower shall be in accordance with the schedule and are minimum allowable. Minimum service factor shall be 1.15 and motors shall not be selected to operate in the service factor. The motor shall be mounted on an adjustable motor base with two adjusting bolts per side. The fan motors shall be factory wired to an external junction box with flexible conduit of adequate length so that it will not have any effect on the vibration isolation.
**H  Coil Sections:**

1. Hot water coil shall be of the plate fin extended surface type. Tubes shall be seamless copper with a 0.020" minimum wall thickness. Tubes shall be mechanically expanded into the fin collars to provide a permanent mechanical bond. Coil return bends shall be minimum one material thickness thicker than the tubes. Return bends shall be brazed. Hairpin return bends shall not be acceptable.

2. The secondary surface shall be die formed of aluminum (copper fins are optional) with thickness as specified on the equipment schedule. Fin spacing shall not exceed 12 fins per inch. Headers shall be non-ferrous material, outside the airstream and provided with brazed male pipe connections. Drain and vent fittings shall be provided for complete coil drainage. All coil connections shall be extended to the exterior of the air handling unit, and into the piping cabinet (doghouse).

3. Coil shall have counterflow construction with connections left or right hand as shown on the drawings. The use of internal restrictive devices to obtain turbulent flow will not be accepted.

4. Coil section shall be provided with coils and access to both sides of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars a connection penetrations. Provide intermediate, piped drain pans when coils are stacked. Provide intermediate supports for coils longer than 60 inches.

5. Cooling coil casings shall be of minimum 16 gauge 304 stainless steel. All other coil casing shall be of 16 gauge galvanized steel. Tube sheets shall have extruded tube holes. All coil assemblies shall be tested under water at 300 psi and rated for 150 psi working pressure.

6. Main drain pans are recessed 16 gauge 304 stainless steel with a double sloped IAQ design to ensure complete condensate drainage. Drain pans are insulated with 2" of urethane foam with an R value of at least 11.5. The insulation is protected by a 20 gauge galvanized steel liner. Coils are to be installed above drain pan. Coils installed with coil casings in the main condensate drain pans are not acceptable.

7. Intermediate condensate pans are to be furnished on multiple coil units and single coils greater than 48" high. The pans shall be 16 gauge 304 stainless steel. Intermediate pans shall extend at least 6" in the direction of airflow and drain to the main drain pan through copper downspouts.

8. All water coils shall be rated in accordance with ARI Standard 410.

9. All DX coils shall be rated for use with R410A and a minimum 580psi rating.

**I  Filter Sections:** Filter sections shall be factory fabricated as part of the air handling unit. Filters shall be arranged for upstream, downstream or side loading into galvanized filter frames with man doors for filter access. Provide filter holding frames to accommodate scheduled filters. Filter rack shall be thoroughly caulked and sealed for minimal filter bypass. Filters shall be MERV 8, 2" (30% efficiency), MERV 13, 4" and MERV 14, 12" (85% efficiency) final, as indicated in schedules. Provide magnehelic filter gauges 3 1/2 diameter diaphragm actuated dial in metal case with static pressure tips.

**J  Damper Sections:** Dampers shall be low leakage type with airfoil blade design. All dampers shall carry the AMCA Standard 500 certification label. Air leakage through a 48" x 48" damper shall not exceed 10 CFM/ft².

1. Blade gasket shall be extruded EPDM elastomer secured in an integral slot within the aluminum extrusion. Frame seals shall be extruded TPE thermoplastic. Overlapping blade design shall compress seals to ensure tight seal on closure.

2. Damper frame shall be extruded aluminum with a thickness of not less than .080" and a depth of 4". Pivot rods shall be 7/16" hexagon extruded aluminum interlocking into blade section.

3. Bearings shall be double seal with an inner bearing fixed to the rod within a polycarbonate outer bearing inserted into the frame so that the outer bearing cannot rotate. Bearings shall be designed so that there is no metal to metal contact.

4. Linkage hardware shall be installed outside of the frame and constructed of corrosion
resistant aluminum and zinc plated steel.

K High Pressure Water Atomization Type Evaporative Humidification System
1. Fog Nozzle Manifolds and Main Feed Lines shall be stainless steel tubes (ASTM A-269, ½” outside diameter, 0.035 inch thick, welded wall). Humidification fog nozzles shall be Type 316 stainless steel body with 0.006 inch diameter low pressure drop nozzle orifice, and matching micro machined 304 stainless steel impaction pin shall be provided. Generating droplets of 17 micron (measured as Mass Median Diameter) at the operating pressure of 1,000 psi with integral filter (40 micron particle size) and fitting into nozzle adapters with o-ring seal (for hand tight installation). All fittings shall be double-ferrule type compression fittings of type 316 stainless steel tubes.

2. Droplet Filters and Frames: Filters shall be UL Class I rated, polymer based with biocide agent. Filters shall be rated for use up to 750 fpm. Filters shall be installed in a stainless steel frame.

3. Drain pans: Drain pans are recessed 16 gauge 304 stainless steel with a double sloped IAQ design to ensure complete drainage. Drain pans shall be insulated with 2” of urethane foam with an R value of at least 11.5. The insulation shall be protected by a 20 gauge galvanized steel liner. Drain pan(s) shall cover entire affected area downstream of the humidifier nozzles.

4. Refer to section 15750-Humidification system for “Fog Pump Unit”, “Water Treatment Equipment”, “RO Treated Water System, Etc.”

L Louvers: Louvers shall be constructed from 18 gauge A60 galvanized steel and painted with same finish as unit exterior. The louver face is lined with 1/2” galvanized mesh bird screen. Louvers shall be designed to collect and drain rainwater to outside of unit. Outside air louvers shall be sized for a maximum face velocity of 500 fpm based on gross louver area. Louvers shall have zero water penetration at 600 ft/min air velocity. Maximum louver pressure drop shall be 0.03’ w.g. at 500 ft/min.

M Weatherhood: Weatherhoods are fabricated from 16 gauge A60 galvanized steel and painted the same finish as unit exterior. Weatherhood openings are lined with 1/2” galvanized mesh bird screen. Weatherhoods are designed for 750 fpm maximum face velocity.

N Fan Air Flow Measuring Stations: The flow measuring station shall consist of total pressure taps located in the inlet cone of each fan, with static pressure tap located near fan inlet panel. Any flow measuring device which creates an obstruction in the fan inlet is not acceptable.
1. Provide a Dwyer magnehelic pressure gauge with CFM scale which indicates the fan volume. Flow gauges shall be calibrated to match the flow coefficient of the fan inlet cone provided.
2. Provide a Setra model 264 electronic differential pressure transmitter mounted to the exterior of the fan section. The transmitter shall be produce a 4 – 20 mA or 0 – 5 Vdc signal linear and scaled to air volume or velocity. The transmitter shall be capable or withstanding over pressurization up to 200 times greater than span and shall be factory calibrated.

O Energy Recovery: Provide a Heatex Air-to-Air Crossflow Heat Exchanger. Corrugated aluminum air-to-air crossflow exchanger. Plates shall be fabricated with the Heatex corrugation pattern, increasing turbulence and heat transfer without creating stagnation points. Flat plate laminar designs are not acceptable.
1. Exchanger shall withstand 7” W.C. maximum differential pressure without permanent deformation
2. Plate corners shall be sealed with MS polymer silicon free sealant and rated for air temperatures up to 190°F.
3. Connecting plate edges shall be folded on automated manufacturing equipment. Adhesive in plate folds shall limit leakage to 0.1% at 1.6” WC differential pressure.
4. Exchanger assembly shall consist of corrugated plate exchanger core, extruded aluminum corner profiles and aluzinc steel endplate framing. Complete assembly shall
form a rigid, stable unit. Exchangers which require rib plate separators or other support for structural reinforcement are unacceptable.

5. Aluminum corner profiles shall be hollow to accept mounting screws.
6. Endplates shall be manufactured with aluzinc coated steel.
7. Exchanger shall withstand 7” WC maximum differential pressure without permanent deformation.
8. Inspection: After installation, the entire transfer surface shall be visible for inspection and cleaning without removing the exchanger. Wider plate spacing facilitated by the high performance corrugated plate configuration shall permit thorough inspection.
9. Performance: Energy recovery performance and pressure drop shall meet the values listed in the schedule.

**Face and by-pass Damper Section:** Dampers shall be low leakage type with airfoil blade design. All dampers shall carry the AMCA Standard 500 certification label. Air leakage through a 48” x 48” damper shall not exceed 10 CFM/ft².

1. Blade gasket shall be extruded EPDM elastomer secured in an integral slot within the aluminum extrusion. Frame seals shall be extruded TPE thermoplastic. Overlapping blade design shall compress seals to ensure tight seal on closure.
2. Damper frame shall be extruded aluminum with a thickness of not less than .080” and a depth of 4”. Pivot rods shall be 7/16” hexagon extruded aluminum interlocking into blade section.
3. Bearings shall be double seal with an inner bearing fixed to the rod within a polycarbonate outer bearing inserted into the frame so that the outer bearing cannot rotate. Bearings shall be designed so that there is no metal to metal contact.
4. Linkage hardware shall be installed outside of the frame and constructed of corrosion resistant aluminum and zinc plated steel.

**Condensing Unit:** The condensing unit is designed specifically for use with VRV series components and shall be factory installed by the air handling manufacturer. All piping and wiring shall also be factory installed. Required control box(s) shall be used to control the flow of R-410a refrigerant to air handling unit connected to a VRV condensing unit. Each control box shall be paired with no more than one expansion valve kit and control the refrigerant flow by measuring the return air temperature and comparing the measured value to the desired set point value.

1. The unit shall be furnished with 2 thermistors required for control of the expansion valve. These thermistors shall be field-installed in the air handling unit as required.
2. The unit shall be furnished with 1 additional thermistor for measuring the return air temperature or room temperature. This thermistor shall be field-installed in the air handling unit or in the conditioned space as required.
3. All refrigerant piping shall be factory preformed and leak tested prior to shipment.

**High-Plume Laboratory Exhaust System**

1. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.
2. Each fan shall be belt driven.
3. Each fan to be equipped with 316 stainless steel lifting lugs for corrosion resistance.
4. Fasteners exposed to corrosive exhaust shall be stainless steel.
   a. CORROSION RESISTANT COATING
      1) All fan system components (fan, nozzle, windband and plenum) shall be corrosion resistant coated with LabCoat#, a two part electrostatically applied and baked, sustainable, corrosion resistant coating system. Standard finish color to be gray
      2) All parts shall be cleaned and chemically prepared for coating using a multi-stage wash system which includes acid pickling that removes oxide, increases surface area, and improves coating bond to the substrate.
3) The first powder coat applied over the prepared surface shall be a zinc rich epoxy primer (no less than 70% zinc) and heated to a gelatinous consistency (partial cure) at which the second powder coat of polyester resin shall be electrostatically applied and simultaneously be cured at a uniform temperature of 400 F.

4) The coating system, a total thickness of up to 6 mils, is not affected by the UV component of sunlight (does not chalk), and has superior corrosion resistance to acid, alkali, and solvents. Coating system shall exceed 4000 hour ASTM B117 Salt Spray Resistance.

5) Note that 10-20 mil thick wet coating systems pollute the environment (air and water), and that these manually applied coatings are not uniform over the impeller surface and can cause fan imbalance and vibration.

b. FAN HOUSING AND OUTLET
1) Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
2) Fan housing shall be welded steel and meet specification section 2.15 for corrosion resistant coating. No uncoated metal fan parts shall be acceptable.
3) Fan housings that are fabricated of polypropylene or fiberglass that have lower mechanical properties than steel, have rough interior surfaces in which corrosive, hazardous compounds can collect, and / or which chalk and structurally degrade due to the UV component of the sunlight shall not be acceptable.
4) A high velocity conical discharge nozzle shall be supplied by the fan manufacturer and be designed to efficiently handle an outlet velocity of up to 6,000 ft/min. Discharge stack caps or hinged covers, impeding exhaust flow shall not be permitted.
5) Provide housing drain for removal of rain and condensation.
6) A bolted and gasketed access door shall be supplied in the fan housing allowing for impeller inspection or removal of impeller, shaft and bearings without removal of the fan housing.

c. FAN IMPELLER
1) Fan impeller shall be centrifugal, backward inclined, with non-stall characteristics. The impeller shall be electronically balanced both statically and dynamically per AMCA Standard 204.
2) Fan impeller shall be manufactured of aluminum (AMCA type B spark resistant), fully welded and meet specification section 2.15 for corrosion resistant coating.

d. FAN BYPASS AIR PLENUM
1) For variable volume systems, a bypass air plenum shall be provided as shown on drawings. The plenum shall be equipped with a bypass air damper and intake air hood with bird screen for introducing outside air at roof level upstream of the fan.
2) The plenum shall be constructed of fully welded steel, meet specification section 2.15 for corrosion resistant coating, and mount on roof curb as shown on the project drawings. Plenums that are fabricated of plastics or resins that are combustible and have mechanical properties less than steel shall not be acceptable.

e. FAN MOTORS AND DRIVE
1) Motors shall be premium efficiency, standard NEMA frame, 1800 or 3600 RPM, TEFC with a 1.15 service factor. A factory-mounted NEMA 3R disconnect switch shall be provided for each fan. Motor maintenance shall be accomplished without fan impeller removal or requiring maintenance personnel to access the contaminated exhaust components.
2) Drive belts and sheaves shall be sized for 200 % of the motor horsepower, and shall be readily and easily accessible for service, if required. Drive shall consist of a minimum of two belts under all circumstances.

3) Fan shaft to be turned and polished of 1040 steel material (optional 316 stainless steel) as standard, coated with corrosion resistant coating.

4) Fan shaft bearings shall be Air Handling Quality, ball or roller pillow block type and be sized for an L-10 life of no less than 100,000 hours. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.

5) All shaft bearings shall have extended lube lines with zerk fittings.

f. SURE-AIRE FLOW MONITORING

1) Flow monitoring station shall monitor the pressure difference between the fan inlet and the smallest diameter of the inlet cone.

2) Volumetric flow to be calculated from empirically derived formulas based on testing by the fan manufacturer.

3) Flow monitoring station shall not use air restricting flow devices that reduce fan performance or create additional fan sound.

4) Four (4) equidistantly spaced sensor orifices to be drilled in the smallest diameter of the inlet cone venturi. Flow tubes from each venturi sensor shall be extended to a termination plate mounted on the fan housing.

5) High-pressure flow port(s) shall be mounted in low velocity fan inlet. Flow ports from the high-pressure sensor shall extend to a termination plate mounted on the fan housing.

6) Flow monitoring station shall accurately measure the pressure differential to within +/- 3%.

7) Flow monitoring station to be installed by the fan manufacturer as part of the standard fan assembly.

8) Flow monitoring station to be supplied with electronics package that includes pressure transmitter and LCD digital readout.

g. ACCEPTABLE MANUFACTURERS

1) Greenheck Fan Corp, PO Box 410, Schofield WI 54476-0410, www.greenheck.com Model Vektor-H [with UL762], High Plume Laboratory Exhaust System.

2) M.K. Plastics, www.mkplastics.com, Model AXIJET-FSW 3000 (or KVC 3000), High Plume Laboratory Exhaust System.

S Operating Controls: Unit manufacturer shall provide package unit with unit control (BACnet) and thermostat terminal board for field controls and wiring by BAS, as described below. Manufacturer shall also install all required dampers for the unit to be controlled by BAS. The controls and actuators, along with required sensors and wiring shall be field installed by BAS contractor per Division section 15980. The unit shall be complete and shipped with all required components, factory installed, to meet all requirements indicated in Division 15, specifically meet the requirement of sequence of operation stated in section 15980.

1. Unit Controller “BACnet”:
   a. AC unit compressors, condenser fans, sequencing, staging, safety and alarm shall be maintained and controlled by the unit manufacturer's internal controls (factory installed unit controller with BACnet protocol). Upon enabling the cooling process by BAS, unit controller (installed by manufacturer) shall operate DX cooling section and control to maintain the discharge temperature setpoint. The unit controller (installed by manufacturer) will maintain the
optimization, dual circuit controls and alarms. The unit controller shall transmit operation of the compressor section to BAS via Bacnet, to monitor and distribute alarms as necessary.

b. Staging Controls:
1) General: Ac unit shall be furnished complete with all operating and safety controls factory installed and wired.
2) Temperature Controls: Provide microprocessor based electronic controller to sequence stages of mechanical cooling and modulate to maintain supply air temperature setpoint, as specified in 15980.
3) Zone control shall incorporate:
   i. Automatic changeover from heating to cooling.
   ii. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.
4) Smoke Detectors: Contractor provided, Factory installed with interlock to stop unit fans upon signal from smoke detectors installed in unit supply as indicated in the schedules (see drawings) coordinated with building fire alarm system.
5) Provide remote temperature sensor capability for field installed controls.
6) BAS Contractor to provide and install additional sensors (pressure, temperature, humidity, etc.) as needed by section 15980.

2. The unit shall also include a factory installed electro-mechanical (low voltage) control system with terminal strip for BAS interface. BAS contractor shall install necessary sensors, actuators, wiring, sensors and controllers to conform with performance requirements as indicated in section 15980. All other functions including but not limited to heating coil controls, humidification controls, face and by-pass dampers controls, unit supply and exhaust fans arrays flow and speed control shall be performed by BAS and be communicated with unit via unit terminal board/buss. Terminal buss shall be capable to provide all additional temperature and pressure sensors that BAS will be required to install per requirements of section 15980.
   a. Units shall be factory wired and tested, and shall be certified by UL/ETL.
   b. All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.
   c. Prewired units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electrical Code, Part 2.
   d. Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays. Provide high limit and combustion air flow switch. Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet the standard of the specific installation.
   e. Temperature Controls: Provide low voltage controller and terminal strip, for interface with controls.

3. Provide factory-wired roof top units with 24 volt control circuit with control transformers, contactor pressure lugs or terminal block for power wiring. Contractor to provide non fused disconnect. Units shall have single point power connections. Field wiring of zone controls to be NEC Class II.

4. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

5. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.
Electrical:
1. Motor Starters: Furnish solid state or electromechanical starters for all auxiliary electric motors required. Contactors for electromechanical starters shall be UL recognized for air conditioning and refrigeration (definite purpose) use and rated in voltage, continuous rated load amperes (RLA) and locked rotor amperes (LRA). The rating shall be equal to or greater than the requirements specified on the compressor motor nameplate.
2. Provide a non-fused disconnect of the proper amp rating in the starter cabinet. Starter shall be furnished with special terminals and internal wiring as required to accommodate controls and power wiring. Starter shall include overload protection devices in each of 3 phases.
3. Mount a permanent nameplate on the unit to display the manufacturer, serial number, model number, date of manufacture, and current and voltage readings and ETL or UL Listing.
4. Provide vapor tight marine lights as specified in the submittal documents, factory wired to a single weatherproof switch located on exterior of cabinet. Provide weatherproof, 15 amps, GFCI receptacle near the light switch wired to the lighting circuit. Separate 120/1/60 power to the light switch shall be provided and installed by others.
5. All wiring shall be run in EMT conduit, raceways are not acceptable. If the unit requires splits, junction boxes shall be furnished on each section to allow the electrical contractor to make final connections in the field. Wiring shall be clearly labeled to facilitate field connection. All wiring shall meet N.E.C requirements.
6. Provide permanent schematic and connection wiring diagrams indicating exactly how the starter was manufactured and wired including the wire terminal numbers.
7. Variable frequency drive for indoor units shall be housed in Nema 1 enclosure. Variable frequency drives for outdoor units shall be housed in suitable NEMA 3R rated enclosures, or in recessed enclosures provided inside the air handling unit, equipped with air-tight access doors and interior cooling provided by circulating conditioned air.
8. Unit mounted controls shall be installed and tested by AHU manufacturer. Controls shall be provided by the temperature controls contractor and shipped to the factory for installation. All wiring must be in conduit.
9. Provide copper wires, bus bars, and fittings throughout, except internal wire of the control transformer may be aluminum, if copper termination is provided. Identify power supply terminals with permanent markers. The maximum temperature of terminals shall not exceed 167°F (75°C) when the equipment is tested in accordance with its rating.

Access Sections: Access sections shall be installed where indicated on the drawings and shall be as specified on the equipment schedule.
1. Access sections shall have double-walled hinged doors.

Safety Handrails: Safety platforms and handrails shall be constructed per requirements of OSHA. AHU manufacturer shall coordinate with contractor and ensure proper means for connection, weight and supports of the safety assembly provided by the air handling unit framing. Shop drawings shall be submitted along with AHU submittal to ensure trouble free field installation by mechanical contractor. Unit total weight, including safety assembly shall not exceed the total allowed structural weight.

Provide manufactured roof curb suitable for both unit housing and piping cabinet.

Testing:
1. Factory Leak Test: Air Handling Unit manufacturer shall provide a witnessed factory leakage test at 1.5 times design static pressure up to a maximum of 12" w.g. Leakage rate at test pressure shall not exceed 1% of design air volume. Unit shall be tested with all openings sealed. A pressure blower with a variable frequency drive shall be used to set the test pressure. CFM shall be determined using a calibrated orifice. Unless specified otherwise, test pressures shall be positive on positively pressurized
sections and negative on negatively pressurized sections of the air handler. A report of all test results shall be written and submitted to Owner's representative for approval.

2. Factory Cabinet Deflection Test: Air handling unit manufacturer shall provide a witnessed factory Panel Deflection Test at the unit design static pressure (1.5 times design static pressure optional). Panel deflection shall not exceed L/200 of longest plane being measured the test pressure. The casing deflection shall be measured at mid point of panel and at panel seam. A report of all test results shall be written and submitted to Owner's representative for approval.

3. Factory Sound Test: Air handling unit manufacturer shall provide factory sound test witnessed by owner's representative, mechanical engineer of record, and mechanical contractor. Tests shall be in accordance to AMCA 320 for sound and AMCA 210 for airflow performance. Noise measurements shall be measured at the Inlet, Outlet and Casing Radiated positions. Costs for travel and lodging to be provided by manufacturer's representatives.

Y Warranty: The manufacturer shall provide a one (1) year parts warranty from the date of startup or 18 months after shipment, whichever comes first.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive air handling unit and fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in conformance with ARI 435.

C. Install the units as shown on the floor plans.

D. Air handling units shall not be operated unless the following requirements (if applicable) are met:
   1. Ductwork is clean and filters are in place
   2. Bearings are lubricated.
   3. Bearing and drive setscrews to be torqued in accordance with the installation instructions.
   4. Belts aligned and fan has been test run
   5. Shipping braces removed
   6. Condensates properly trapped.
   7. Pipe housing drain to nearest drain.
   8. Install fans in accordance with manufacturer's Installation, Operation and Maintenance manual piping connections verified and leak tested.
   9. Install fans as indicated, with flexible electrical leads.

END OF SECTION
SECTION 15885
AIR CLEANING

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 factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 DEFINITIONS

A. DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate.
B. HEPA: High-efficiency particulate air.
C. ULPA: Ultra low penetration air.

1.4 SUBMITTALS

A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.
   1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
   2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.

C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ARI 850.

D. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.

E. Comply with NFPA 70 for installing electrical components.
F. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Provide one complete set of filters for each filter bank. If system includes prefilters, provide only prefilters.
   2. Provide one container of red oil for inclined manometer filter gage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Filters, and Filter-Holding Systems:
      a. Ecco Air
      b. Camfil Farr Co.
      c. Camfil Durafi Co.
      d. Cambridge
   2. Filter Gages:
      a. Cambridge Filter Corp.
      b. Dwyer Instruments, Inc.

2.2 EXTENDED-SURFACE, DISPOSABLE PANEL FILTERS

A. Description: Factory-fabricated, dry, extended-surface filters with holding frames.

B. Media: Fibrous material formed into deep-V-shaped pleats with anti-microbial agent and held by self-supporting wire grid.

C. Media and Media-Grid Frame: Fire-retardant, 3/4-inch particleboard with gaskets.

D. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

2.3 COMMODITY AND ASHRAE TYPE FILTERS - GENERAL

A. Commodity type filters are specified as "commodity-type" or "ASHRAE-type because it is intended that these filters fit within the range of filters generally covered by ASHRAE standards or manufactured by most filter manufacturers. These filters are distinguished from "specialty-type" filters because specialty filters may have some specific feature or absorption capability which is required by the Owner and is only manufactured by a single manufacturer.

B. Manufacturer's names and catalog numbers given hereafter are intended to establish type, size, performance and standard of quality.

C. Provide filter media for all air handling units, and replacement roof top air handling units, and at other locations as shown and scheduled on the drawings.
D. Provide throw-away type filter media for all packaged terminal equipment such as fan coil units, cabinet unit heaters, and fan powered terminal boxes. Refer to the drawing schedules. Filter media shall be the size required by the terminal equipment device.

2.4 ASHRAE 30 PERCENT EFFICIENCY FILTERS (MERV 8)

A. Provide 30 Percent Efficiency (MERV 8) Air Filters of the size and depth as scheduled on the drawings and as specified in other sections of this specification. Air filters shall be the pleated, disposable type. Each filter shall consist of synthetic fabric media, media support grid, and enclosing frame. The filter shall be listed as Underwriters’ Laboratories Class 2 (or Class 1).

B. The media shall have an average efficiency of 25-30% (MERV 8) when tested under ASHRAE Standard 52.1-1992 (52.2-1999).

1. For 1 inch deep filters, the effective filter media shall be not less than 1.9 square feet of media per square foot of filter face area. There shall be not less than 14 pleats per linear foot of filter face area. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.45” w.g. Filter shall be rated for a final pressure drop of not less than 1.0” w.g.

2. For 2 inch deep filters, the effective filter media shall be not less than 4.4 square feet of media per square foot of filter face area. There shall be not less than 14 pleats per linear foot of filter face area. Initial resistance at 500 feet per minute approach velocity shall not exceed 0.30” w.g. Filter shall be rated for a final pressure drop of not less than 1.0” w.g.

3. For 4 inch deep filters, the effective filter media shall be not less than 6.7 square feet of media per square foot of filter face area. There shall be not less than 10 pleats per linear foot of filter face area. Initial resistance at 600 feet per minute approach velocity shall not exceed 0.35” w.g. Filter shall be rated for a final pressure drop of not less than 1.0” w.g.

C. The media support grid shall be constructed of a corrosion resistant expanded metal backing.

D. The enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board. Diagonal support members, of the same construction, shall be bonded to the air entering and air exiting side of each pleat. The inside periphery of the enclosing frame shall be bonded to the filter pack eliminating the possibility of air bypass.

E. The filter shall be identified on the enclosing frame as to manufacturer, model, and U.L.Class rating.

2.5 ASHRAE HIGH EFFICIENCY FILTERS (MERV 11, 13, 14 AND 16)

A. Provide high-efficiency ASHRAE pleat-in-pleat V-bank disposable type assembled, air filter in a compact and secure enclosing frame. Filter media shall be of micro fine glass formed into uniformly spaced pleats separated by hot melt separators and formed into a mini-pleat pack design. Each mini-pleat pack shall be assembled into a V-bank configuration with an appropriate number of packs to obtain required pressure drop.

B. The filter shall have a Minimum Efficiency Reporting Value of MERV (11, 13, 14, 16) when evaluated under the guidelines of ASHRAE Standard 52.2. It shall have a MERV-A of (11, 13, 14, 16) when tested using appendix J of that standard.

1. Initial resistance to airflow shall be (0.22”, 0.27”, 0.29”, 0.64”)* w.g at an airflow of 500 fpm.

2. Filter shall be rated by Underwriters Laboratories as UL Class 900.


C. The media packs shall be bonded to the inside periphery of the enclosing frame with a fire-retardant phosphorus-free sealant.
D. The enclosing frame should be comprised of ABS plastic. Rigid plastic end caps shall be mechanically fastened to the top and bottom of the enclosing structure to ensure a rigid and durable filter.

E. The filter shall be identified on the enclosing frame as to manufacturer, model, and U.L.Class rating.

2.6 FILTER GAGES

A. An Air Filter Gauge for measuring the resistance to airflow through the filters shall be installed. Each housing shall include one gauge (magnehelic type) for measurement of pre-filter, final filter, and/or total filter bank resistance.

B. The air filter gauge shall be diaphragm actuated, shall have 3-7/8” diameter white dial with black figures and graduations, shall have zero adjustment, shall be furnished with two static pressure tips, fittings for 1/4” metal or plastic tubing, and a means for mounting the gauge. Gauge graduations shall be from 0”-3”.

C. A three-way gauge cock and fittings shall be provided to allow measurements relating to three tap locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filter frames according to manufacturer’s written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Install filter gage for each filter bank.

E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

F. Coordinate filter installations with duct and air-handling unit installations.

G. Electrical wiring and connections are specified in Division 26 Sections.

H. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

3.2 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components, filter and filter-frame installation, and electrical wiring, and to assist in field testing. Report results in writing.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-
distribution systems, clean filter housings and install new filter media.

END OF SECTION
SECTION 15890

DUCTWORK

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. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   4. Sealants and gaskets.
   5. Hangers and supports.
   7. Medium Pressure Ductwork

B. Related Sections:
   1. Section 15990 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 15910 "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
   1. SMACNA + 2.0" w.g. static pressure class and 2500 FPM maximum velocity.
      a. Relief air ductwork.
      b. Outside air ductwork.
      c. Supply air ductwork from VAV terminals to air devices.
   2. SMACNA - 2.0" w.g. static pressure class and 2500 FPM maximum velocity.
      a. Return air ductwork.
      b. Outside air ductwork

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE 7.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:
   1. Sealants and gaskets.
   2. Seismic-restraint devices.
   3. Duct Construction Standards

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:
1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE


B. Welding Qualifications: Qualify procedures and personnel according to the following:

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS
A. General Fabrication Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams – Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Linda Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible."
2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM a 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 MEDIUM PRESSURE DUCTS

A. Fabricate and support in accordance with SMACNA Medium Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

D. Fabricate continuously welded medium pressure 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.

2.5 SEAMS AND JOINTS

A. Longitudinal seams shall be Pittsburgh, or equal (no known equal) lock with 3/8 inch minimum pocket.

B. Round Ductwork: Transverse joints in low pressure round ducts to be beaded sleeve joint secured with sheet metal screws equally spaced on 6 inch centers maximum with a minimum of 3 screws per joint. Round duct elbows shall be stamped or segmented; adjustable elbows are not acceptable. Seal joints with sealant.

C. Rectangular Ductwork: Construct all seams and joints in rectangular ductwork in accordance with SMACNA "HVAC Duct Construction Standards," Seal all transverse joints with duct sealant.

D. Seal each duct transverse joint and longitudinal seam with a duct sealant. Use hardcast DT tape with RTA adhesives or equal (no known equal), for exterior ductwork.
2.6 FITTINGS FOR MEDIUM PRESSURE DUCTS

A. Elbows: All elbows shall have an inside radius not less than the width of the ducts in the direction of the curve. Where space conditions do not permit a full radius elbow, changes in direction shall be made using mitered elbows with multiple double thickness turning vanes.
   1. Construct radius elbows in accordance with the "HVAC Duct Construction Standards," Short radius elbows are not allowed.
   2. Construct vaned elbows of double vanes in accordance with the "HVAC Duct Construction Standards," Single vane elbow shall not be used.

B. Construct transitions and offsets in accordance with the "HVAC Duct Construction Standards,"
   1. Transitions: Maintain full duct cross section areas through transitions. Angle between centerline and side of diverging transition shall be no greater than 15 degrees in lieu of 20 degrees shown in the "Low Pressure Duct Manual." Angle between centerline and side of converging transition shall be no greater than 30 degrees.
   2. Offsets: Construct with inside radii not less than the width of the duct in the direction of the curbs. Mitered elbows as specified under Subparagraph, "Elbows," herein may be used where space is restricted.

C. Collar taps for air outlet connections on exposed ductwork to be made with joint connection folded over inside of main duct and without exposed flanges. Outlet collar to be of same dimension as outside dimension of air outlet frame.

D. Make branch connections in accordance with SMACNA and as otherwise indicated on the Drawings.

E. Outlet Frames: Where ducts terminate at grilles, registers or diffusers, furnish with angle or channel iron frames with mitered welded corners and with provisions for attaching said grilles, registers, or diffusers.

F. Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Size doors for maintenance of concealed items. Construct access doors in accordance with "HVAC Duct Construction Standards," Furnish hinged doors except where space does not allow the door to swing open furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.

G. Make connections between ductwork and outlets with flexible duct material herein specified. (Unless otherwise specified on drawings).

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg. positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare),
stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
2. Type: S.
3. Grade: NS.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

2.9 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
5. Mason Industries.
6. TOLCO; a brand of NIBCO INC.
7. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and
enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA’s “Duct Cleanliness for New Construction Guidelines.”

M. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. (Unless otherwise specified on drawings).

N. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

O. Adhere to Drawings: Run and shape of ducts offsets during progress of work may be varied, if required to meet structural or other interferences, as approved.

P. Install ductwork in adherence to ceiling height shown on Drawings. Establish necessary space requirements so as to maintain required clearances around all equipment.

Q. Reinforce all ducts to prevent buckling, breathing, vibrations or noise, such reinforcing shall be as recommended in the reference specified herein.

3.2 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, “Standard Duct Sealing Requirements,” unless otherwise indicated.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   3. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.
E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC-RERAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE 7.
   1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
   2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have
duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
2. Test the following systems:
   a. Supply air.
   b. Exhaust air.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before insulation application.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
6. Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing agency which will be contracted by the Owner can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.
7. Test Equipment: Use equipment arranged as recommended by the testing and balancing agency specified in Section 15990.
8. Field Test Procedures
   a. Seal all openings in duct section to be tested.
   b. Connect test apparatus to test section of duct, using a flexible duct connection or hose.
   c. Close damper or blower suction side to prevent excessive buildup of pressure.
   d. Start blower and gradually open damper on suction side of blower.
   e. Build up pressure in duct test section to 4 inches WG.
   f. Record indicated pressure or instrument that is connected to section of duct under test.
   g. Maintain this pressure for ten minutes and check for audible leaks. Mark location of each leak.
   h. Reduce pressure to 0 inch WG and repair all visual and audible leaks.
   i. Upon completion of repairs, build up pressure to design operating pressure, and read leakage pressure on instrument connected across test apparatus orifice.
   j. Leakage C.F.M. to be read by consulting chart calibrated with orifice diameter. If no leakage exists, zero pressure differential shall be indicated. Leakage C.F.M. shall not exceed 3%. Repeat procedure as indicated above until leakage rate is met.
9. Engage the testing agency specified in Section 15990, to verify the leakage tests of all ducts and submit a certification attesting to the results obtained.
10. Tested sections of ductwork to be visually marked by agency with certification sticker and initials of field test inspector. Tests shall be made before duct sections are concealed.

C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media
shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Adjustment and cleaning.
   1. Balancing and Adjusting: Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Intermediate Reinforcement:

C. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 2-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
         2) Mitered Type RE 4 with turning vanes.
      b. Velocity 1000 to 1500 fpm:
         1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
         2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
         1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio...
         2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
   2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
      a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3 1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
         1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
         2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
         3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      a. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
      b. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.
   D. Branch Configuration:
      1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
         a. Rectangular Main to Rectangular Branch: 45-degree entry.
         b. Rectangular Main to Round Branch: 45 degree entry with transition to round.
      2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-6, "Round Duct Elbows."
Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees."

a. Velocity 1000 fpm or Lower: 45 degree lateral
b. Velocity 1000 to 1500 fpm: 45 degree lateral.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION
PART 1 - GENERAL

1.1 WORK DESCRIPTION

A. Provide ductwork accessories complete for the air distribution system, as indicated on the Drawings and as specified.

1.2 SUBMITTALS

A. Submit the following items:
   1. Flexible connections.
   2. Volume dampers.
   3. Diffusers, registers and grilles.
   5. Duct access doors.
   7. Test holes.

1.3 QUALITY ASSURANCE

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Flexible Connections: Six-inch flexible connections shall be installed between all rigid ductwork or casing and all air handling equipment. Connections shall be of fireproof material and manufactured for temperatures and pressures involved. Allow at least 1 inch slack in these connections to insure that no vibration is transmitted from fan to ductwork. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage. Material shall be "Ventglas" by Ventfabrics, Inc., Vibration Mounting and Controls, Inc.
   1. Flexibles at roof fans.
   2. Acoustic floor.

B. Volume Dampers
   1. Provide Volume Damper (VD) at each branch duct and as indicated on Drawings for supply, return, and exhaust air duct systems. Provide five (5) diameters distance from first outlet/inlet.
   2. Comply with SMACNA “Side Elevation” and Text on Volume Dampers" for all details except as specified herein on single blade and two bladed damper for 2" W.G. Class duct. Provide each damper with a closed end bearing. 3. Use 3/8” continuous square rod and 18 gauge galvanized stiffened blade for damper blade sizes 18” wide by 18” high and smaller or 12” diameter and smaller.
   3. Use 1/2” continuous square rod and 16 gauge galvanized stiffened blade for damper blades sizes 19” to 48” wide by 10” high. Maximum blade size is 48” by 10” high. Maximum diameter is 16”.
   4. Maximum of two blades without a frame: Over two blades, use a manufactured 16 gauge galvanized, stiffened, opposed blade damper in a 14 gauge galvanized steel frame. Galvanize all hardware except use brass trunions and bronze oilite bearing; Pacific Air Products, Series 200; Putterf Series 400.
5. Quadrant shall be Durodyne Model 3/8" K-4/1/2" K-5 Quadline; Ventloxo Model 555 Ventline.
6. Provide closed end bearing, Durodyne SB-338 (3/8")/SB-312 (1/2"; Ventloxo Model 609.
7. Cut slot in end of damper rod (Quadrant End) to indicate blade position.
8. Provide galvanized sheet metal "hat section" on ducts with exterior insulation so that quadrant will be exposed.
9. Install each square rod vertical or horizontal so that quadrant shall be accessible for adjusting.
10. Provide 24" x 24" access for each volume damper, and fire dampers that is not accessible as approved by Owner.
11. Remote operated dampers VD(R), shall be operated via Young Regulators (or equal, No known equal).
12. Provide additional dampers required for correct balance as recommended by the test agency, which will be installed by the Contractor at no additional cost.

C. Duct Test Holes
1. Cut or drill temporary test holes in ducts as required. Cap with threaded metal caps.
2. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

D. Duct Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Doors shall be sized for maintenance of concealed items. Construct access doors in accordance with SMACNA "Low Pressure Duct Manual." Furnish hinged doors except where space does not allow the door to swing open. Furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.

E. Motorized Dampers
1. Dampers shall be provided for outside air as shown on the Drawings.
2. Damper frames shall be 16 gauge galvanized steel hat channels. Blades shall be 18 gauge galvanized steel, 7-1/4 inch width, maximum length 48 inches. Axles shall be 1/2 inch diameter galvanized steel stub. Bearings shall be heavy duty self-lubricating nylon.
3. Dampers shall be low leakage, opposed blade type. Pressure drop for opposed blade dampers shall not exceed .55 inch W.G. at the full open position and at the face velocity of 3000 FPM.
4. Dampers shall be internally mounted driven with blades.
5. Dampers shall be low leakage type. Damper blades shall be equipped with dual duometer vinyl seals. Jambs shall have metallic compression seals. Leakage shall not exceed 4-5 cfm per square foot at 2 inch w.g. differential pressure.

F. Backdraft Dampers
1. Gravity silent type backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
2. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gage stainless steel with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

G. Acoustic Flexible Connectors: Acoustic flexible ducts shall be listed by Underwriters’ Laboratories under UL Standard 181 as Class I flexible air duct and complying with NFPA Standards 90A and 90B. Duct shall be factory-made and composed of a CPE liner duct permanently bonded to a coated spring steel wire helix and supporting a fiberglass insulating blanket with fiberglass scrim. Low permeability outer vapor barrier shall complete the assembly.
H. Diffusers and Registers

1. Ceiling Supply Diffusers: Removable face, flush-mounted, horizontal supply, air pattern rectangular diffuser. Reflectrols are to be supplied to assure uniform distribution of air to diffuser when the distance from the takeoff to the diffuser face is less than the recommended minimum by the manufacturer. Provide opposed blade type volume control dampers with each diffuser for fine tuning during air balancing. Throw from the center of the diffuser shall be adjusted to 75 percent of the distance between the diffuser and the wall or 35 percent of the distance between the two diffusers. Titus, Krueger, Carnes or equal.

2. Ceiling Return and Exhaust Register: Removable, face, flush-mounted rectangular grille with round neck.

3. Manufacturers: Titus, Krueger or Carnes or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install ductwork accessories in accordance with the manufacturer's printed instructions and approved Shop Drawings.

END OF SECTION
SECTION 15930
LABORATORY PRESSURIZATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY.

A. A Laboratory Airflow Control System (LACS) shall be furnished and installed under this section. The LACS shall be capable of operating as a standalone system or as a system integrated with the Building Management System (BMS) or Building Automation System (BAS).

1.2 REFERENCES.

A. Abbreviations and Acronyms
1. ATC – Advanced Temperature Control
2. BMS – Building Management System
3. BAS – Building Automation System
4. LACS – Laboratory Airflow Control System
5. UBC – Usage Based Controls
6. VAV – Variable Air Volume
7. TTW – Through The Wall (sensor)
8. ZPS – Zone Presence Sensor
9. PIN – Personal Identification Number

B. Reference Standards
1. Air Conditioning and Refrigeration Institute ARI 880 Performance Rating of Air Terminals

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination
1. The LACS representative shall coordinate all details of the installation with mechanical contractor. This effort shall include complete coordination of the sheet metal layout drawings to assure that the ductwork layout and sizing is based on the actual sizes of the airflow control valves for this project.

1.4 SUBMITTALS

A. General: Submit listed Submittals in accordance with Conditions of the General Contract and Division 1 Submittal Procedures Section. LACS submittals shall contain, at a minimum, the following information:
1. Product Data Sheets
2. Equipment Schedule Sheets containing Room#, Tag#, Min/Max flows, Catalog# and other configuration data as required to provide a fully engineered LACS.
3. Installation Instructions
4. Project-specific Wiring Diagrams
5. Points Lists
1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided as closeout submittals.

B. Integration checklists are encouraged; once the integration to the BMS or BAS is completed, it is recommended that the LACS representative meet with the BMS or BAS contractor to do a final acceptance test of the integration. This testing should include:
   1. Testing points to ensure communication
   2. Testing setpoints such as temperature, occupancy, room offset, etc.
   3. Testing various alarms in different parts of the system
   4. Testing to ensure that equipment will cycle after a power loss

1.6 QUALITY ASSURANCE

A. Certifications
   1. The laboratory airflow system provider shall be an entity that designs, develops, and manufactures products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2008.
   2. The Laboratory airflow system provider shall be ROHS compliant in all its products
   3. The airflow control (Venturi) valves shall be calibrated using NIST traceable equipment AND NVLAP accredited air stations.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements
   1. Prior to installation, the LACS shall be stored in dry conditions within an environment complying with LACS product specifications as shown on product data sheets within the submittals.
   2. The LACS products shall be handled and transported in a manner consistent trade practices for control systems and instruments.

1.8 SITE CONDITIONS

A. The ambient environmental conditions during installation and operation shall comply with LACS product specifications as shown on the product data sheets within the submittals.

1.9 WARRANTY

A. The Warranty shall commence upon the date of shipment and extend for a period of 60 months for all airflow control devices and 36 months for all other control system components.

PART 2 - PRODUCTS

2.1 LABORATORY AIRFLOW CONTROL SYSTEMS (LACS)

A. LACS shall be furnished and installed to control the airflow into and out of laboratory rooms. The exhaust flow rate of a laboratory fume hood shall be controlled precisely to maintain a constant average face velocity into the fume hood at either a standard/in-use or standby level based on an operator’s presence in front of the fume hood. The laboratory control system shall vary the amount of make-up/supply air into the room to operate the laboratories at the lowest possible airflow rates necessary to maintain temperature control, achieve minimum air change rates and maintain laboratory pressurization in relation to adjacent spaces as shown in the drawings. The LACS shall be capable of operating as a standalone system or as a system integrated with the Building Management System (BMS). A locally mounted user interface
terminal shall be available by BAS Contractor to allow room-level control variables to be displayed, and edited to adjust control operation.

2.2 COMPONENTS

A. Usage based control® equipment

1. A sash sensor shall be provided to measure the height of each vertically moving fume hood sash. A sash sensor shall also be provided to measure the opening of horizontal overlapping sashes. Sidewall-mounted or through the wall (TTW) sensors could be used as a reference.

2. A Zone Presence Sensor (ZPS) shall be provided to determine an operator’s presence in front of a hood by detecting the presence and/or motion of an operator, and to command the LACS from an in-use operating face velocity (e.g., 100 fpm) to a standby face velocity (e.g., 60 fpm) and vice versa. The sensor shall define an adjustable detection zone that extends approximately 20 inches (50 cm) from the front of the fume hood. If the sensor does not detect presence and/or motion in its detection zone within 30 to 3,000 seconds, it shall command the system to the user-adjustable standby face velocity. When the sensor detects the presence and/or motion of an operator within the detection zone, it shall command the system to the in use face velocity within 1.0 second.

b. The sensor shall sense an inanimate object when placed in the detection zone and remain in the standard mode of operation for 30 to 3,000 seconds, after which it will return to a standby mode. Operators shall enter and leave the zone with the unit adjusting automatically between in-use and standby modes. If the inanimate object is moved or taken out of the zone, the unit shall adapt to the change automatically.

c. The sensor shall have an adjustable detection zone capable of covering a fume hood up to eight feet wide and be mounted from six(6) to twelve(12) feet above the floor surface.

d. The sensor shall be configurable for varying levels of lighting intensity and motion sensitivity.

e. The sensor shall have the ability to operate on either AC or DC power sources.

f. Wide area motion detectors (on the hood or at the room level) shall not be acceptable.

g. Motion detectors that rely solely on Doppler shift radar or similar technology for motion detection shall not be acceptable.

3. The airflow at the fume hood shall vary in a linear manner between two adjustable minimum and maximum flow set points to maintain a constant face velocity throughout this range. A minimum volume flow shall be set to assure flow through the fume hood even with the sash fully closed.

B. Airflow control device - general

1. The airflow control device for design base selection shall be Phoenix Controls Accel II pressure independent venturi valve.


3. All Components of the valve, its controllers, and wiring shall be ROHS compliant.

4. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure irrespective of the magnitude of pressure and/or flow change or quantity of airflow controllers on a manifolded system.

5. The airflow control device shall maintain accuracy within ±5% of signal over an airflow turndown range of no less than:

   a. 12.5 to 1 (medium pressure all valve sizes)
   b. 16 to 1 (medium pressure w/o 14” valve)
c. 7 to 1 (low pressure all valve sizes)
d. 11 to 1 (low pressure w/o 14” valve)
e. 8 to 1 (medium pressure shut-off all valve sizes)
f. 14 to 1 (medium pressure shut-off w/o 14” valve)
g. 5 to 1 (low pressure shut-off all valve sizes)
h. 9 to 1 (low pressure shut-off w/o 14” valve)

6. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.

7. No rotational/axial orientation requirements shall be required to ensure accuracy and/or pressure independence.

8. The airflow control device shall maintain pressure independence regardless of loss of power.

9. The airflow control device shall be constructed of one of the following four types:
   a. Class A—The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and internal “S” link shall be made of 316 stainless steel. The shaft support brackets shall be made of galvanized (non shutoff valves) or 316 stainless steel (shutoff valves). The pivot arm shall be made of aluminum (for non shutoff valves) and 303/304 stainless (for shut off valves). The pressure independent springs shall be a spring-grade stainless steel. All shaft bearing surfaces shall be made of a PP (polypropylene) or PPS (polyphenylene sulfide) composite. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.
   b. Class B—The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal “S” link shall be made of 316 or 303 stainless steel. The pressure independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft bearing surfaces shall be made of PP (polypropylene) or PPS (polyphenylene sulfide) composite.

10. Actuation
   a. For high speed electrically actuated VAV operation, a CE certified electronic actuator shall be factory mounted to the valve. Loss of main power shall cause the valve to position itself in an appropriate failsafe state. Options for these failsafe states include: normally open-maximum position, normally closed-minimum position and last position. This position shall be maintained constantly without external influence, regardless of external conditions on the valve (within product specifications). High Speed Actuation shall, within 1 second, drive the valve to its commanded position, and park without over-driving, under-driving, back-driving, or hunting.
   b. For Standard Speed electrically actuated VAV operation, a CE certified electronic actuator shall be factory mounted to the valve. The failsafe state for standard speed operation valves shall be fail to last position unless otherwise noted. Standard speed actuators shall drive the valve to its commanded position and park without over-driving, under-driving, back-driving, or hunting within a typical time period of approximately 30-45 seconds. Standard speed actuation should not be used for valves that are connected to fumehoods.
   c. Constant volume valves do not require actuators.

11. The controller for the airflow control devices shall be microprocessor based and operate using peer-to-peer control architecture. The room-level airflow control devices shall function as a standalone network.

12. The room-level control network shall utilize a BACnet or LonTalk communications protocol.

13. There shall be no reliance on external or building-level control devices to perform room-
level control functions. Each laboratory control system shall have the capability of performing fume hood control, pressurization control, temperature control, humidity control, and implement occupancy and emergency mode control schemes.

14. The LACS shall have the option of digital integration with the BAS.

15. NVLAP Accreditation (Lab Code 200992-0)

   a. Each airflow control device shall be factory characterized on air stations NVLAP Accredited (a program administered by NIST) to ISO/IEC 17025:2005 standards.

   b. Each airflow control device shall be factory characterized to the job specific airflows as detailed on the plans and specifications using NVLAP Accredited air stations and instrumentation having a combined accuracy of no more than ±1% of signal (5,000 to 250cfm), ±2% of signal (249 to 100cfm) and ±3% of signal (199 to 35cfm). Electronic airflow control devices shall be further characterized and their accuracy verified to ±5% of signal at a minimum of 48 different airflows across the full operating range of the device.

   c. Each airflow control device shall be marked with device-specific factory characterization data. At a minimum, it should include the room number, tag number, serial number, model number, eight-point characterization information (for electronic devices), date of manufacture and quality control inspection numbers. All information shall be stored by the manufacturer for use with as-built documentation. Characterization data shall be stored indefinitely by the manufacturer and backed up off site for catastrophic event recovery.

16. Airflow control devices that are not venturi valves and are airflow measuring devices (e.g., pitot tube, flow cross, air bar, orifice ring, vortex shedder, etc.) shall only be acceptable, provided these meet all the performance, factory sequences and construction characteristics as stated throughout this specification and:

   a. The airflow control device employs transducers with an accuracy no less than ±0.15% of span (to equal ±5% of signal with a 15 to 1 turndown) over the appropriate full-scale range, including the combined effects of nonlinearity, hysteresis, repeatability, drift over a one-year period, and temperature effect. 316L stainless steel materials shall be provided for all exhaust applications. The use of 304 stainless steel or aluminum materials shall be provided for all supply air applications.

   b. Airflow sensors shall be of a multi-point averaging type, 304 stainless steel for all supply and general exhaust applications, 316L stainless steel for all fume hood, canopy, snorkel, and biosafety cabinet applications.

   c. Suppliers of airflow control devices or airflow measuring devices requiring minimum duct diameters shall provide revised duct layouts showing the required straight duct runs upstream and downstream of these devices. Coordination drawings reflecting these changes shall be submitted by the supplier of the LACS for Architect and Engineer’s review and approval. In addition, suppliers shall include static pressure loss calculations as part of their submittals. Owner shall not bear any cost(s) for modification to the ductwork, increase fan sizes and horsepower and all associated electrical changes that may arise due to this substitution by the LACS supplier.

C. Exhaust and supply airflow device controller

1. The airflow control device shall be a microprocessor-based design and shall use closed loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.

2. The airflow control device shall be able to command a venturi valve to a flow setpoint, drive the valve to that setpoint, record the appropriate feedback without under-driving, over-driving, or hunting within:

   a. 1 second or less with high speed actuation

   b. 30-45 seconds for standard speed actuation

3. The airflow control device shall store its control algorithms in non-volatile, re-writeable memory. The device shall be able to stand-alone or to be networked with other room-
level digital airflow control devices using an industry standard protocol.

4. Room-level control functions shall be embedded in and carried out by the airflow device controller using distributed control architecture. Critical control functions shall be implemented locally; no room-level controller shall be required.

5. The airflow control device shall use industry standard 24 VAC power.

6. The airflow control device shall have provisions to connect a Phoenix Controls Workbench commissioning tool (or a remote user interface). Every node on the network shall be accessible from any point in the system.

7. The airflow control device shall have built-in integral input/output connections that address fume hood control, temperature control, humidity control, pressure control, occupancy control, emergency control, and non-network sensors switches and control devices. At a minimum, the airflow controller shall have:
   a. Three universal inputs capable of accepting 0 to 10 VAC, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3 10 K ohm @ 25 degree C thermistor temperature sensors.
   b. One digital input capable of accepting a dry contact or logic level signal input.
   c. Two analog outputs capable of developing either a 0 to 10 VAC or 4 to 20 mA linear control signal.
   d. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 VAC/VAC.

8. The airflow control device shall meet FCC Part 15 Subpart J Class A, CE, and CSA Listed per file #228219.

9. The airflow control device shall be ROHS compliant

D. Shut-off airflow control device
   1. Two types of shut-off air flow devices shall be available; standard shut-off (no gasket) and low leakage shut-off (with gasket).
   2. The shut-off airflow control device shall have shut-off leakage and casing leakage of no greater than the following (with 5.0" WC static pressure):

<table>
<thead>
<tr>
<th>Shut-off Valve Type and Airflow Range</th>
<th>Shut-off Leakage</th>
<th>Casing Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard shut-off devices up to 1600 CFM (472 l/s)</td>
<td>6 CFM</td>
<td>0.060 CFM</td>
</tr>
<tr>
<td>Low leakage shut-off devices up to 850 CFM (472 l/s)</td>
<td>0.005 CFM</td>
<td></td>
</tr>
<tr>
<td>Low leakage shut-off devices up to 1,300 CFM (708 l/s)</td>
<td>0.010 CFM</td>
<td></td>
</tr>
</tbody>
</table>

3. Manufacturer shall provide comprehensive leakage charts generated from ASME N510 pressure decay testing. Standard shut-off devices shall be tested up to and including 5" WC static pressure. Low-leakage shut-off devices shall be tested up to and including 30" WC static pressure.

E. Two-position exhaust airflow control device
   The airflow control device shall maintain a factory characterized fixed maximum and minimum flow set point based on a remote contact/sash switch for electronic valves or a switched 0 to 20 psi pneumatic signal for pneumatic valves. Two-position devices requiring feedback shall generate a 0 to 10 volt feedback signal that is linearly proportional to its airflow. All two-position devices shall be either networked or hard-wired into the room-level network so as to be considered under pressurization control.

F. Laboratory office airflow control device
   The airflow control device shall maintain a temperature set point by controlling the airflow and the reheat valve (if required) in response to a room temperature sensor. An additional output shall be provided for supplementary cooling or heating of the office space. If the office airflow supply device is not required for make-up airflow control for fume hoods, then the one-second speed of response and fail-safe conditions required of the LACS shall not apply.
G. Constant volume airflow control device
   1. The airflow control device shall maintain a constant airflow set point. It shall be factory characterized and set for the desired airflow. It shall also be capable of field adjustment for future changes in desired airflow.
   2. LACS suppliers not employing constant volume venturi airflow control valves shall provide pneumatic tubing or electrical wiring as required for their devices.

H. Fume hood display
   1. The display screen shall be a Phoenix Controls Sentry 3.2" color LCD resistive touch screen (240 x 320 RGB).
   2. The touch screen shall support input configurations for fume hood operational parameters done at the touch panel and at a minimum including:
      a. Sash Dimensions
      b. Hood ID
      c. Hood Certification Reminder
      d. Hood Occupancy Status
      e. Stopwatch/Timer
      f. Message Display
   3. Hood configuration for the following properties shall be viewable and editable from the touch display:
      a. Sash Dimensions
      b. Hood ID
      c. Hood Certification Reminder
      d. Hood Occupancy Status
      e. Stopwatch/Timer
      f. Message Display
   4. The enclosure shall be made from material that is resistant to chemicals that are typically used in the lab for wipe down and general cleaning agents.
   5. The unit’s exposed surfaces shall be chemically resistant to vaporized hydrogen peroxide (VHP), formaldehyde, chloride dioxide (clidox), perchloric acid, sodium hypochlorite 3-6% (bleach), and quaternary ammonium 7% in 1:128 tap water (ammonia).
   6. Two mechanical membrane buttons shall be provided at the front panel of the display to enable users to quickly activate emergency exhaust mode and mute without having to remove protective gloves.
   7. Flush mount or recess mount shall be installation options.
   8. A USB port shall be provided to support firmware and software upgrades and shall be covered to protect against moisture or corrosion.
   9. A timer feature shall be provided to enable users to set specific time to time the duration for experiments and provide visual and audible alarms when the set time is expired.
   10. The fume hood display shall have an available I/O at the controller which may be used to receive a 0 – 10 volt signal from other devices such as a Through-The-Wall (TTW) sensor. The TTW shall not control the valve but provide a drift alert to indicate when the TTW sensor reading is out of range relative to the sash position face velocity value.

I. Power
   1. The device shall be powered by 24 VAC ± 15% at 10VA, 50/60 Hz.

J. Configuration
   1. Configuration shall be performed from the touch display, user interface keypad and/or manufacturer’s software tools.
   2. The device shall be capable of being added to a BACnet or LON communication network.
   3. The device shall display Fume hood performance data based on control logics embedded inside the valve controller.
K. Communication
1. The fume hood display unit shall connect to LON or BACnet communication and link directly to a specific valve (or room) controller associated with the hood it is mounted to.
2. The device shall display fume hood performance data based on the valve controller performance and sash movements over LON or BACnet.

L. Information display
1. The device shall have the ability to show when the fume hood face velocity is within the normal operating range, energy saving, hood certification, hood ID, timer, and hood occupancy status.
2. The device shall be configurable to display one of the following measurement units: cubic feet per minute (CFM), meters cubed per hour (m³/h), liters per second (l/s), feet per minute (fpm), or meters per second (m/s).
3. The device shall have the ability to display system errors caused by the airflow valve or sash travel.
4. The device shall have the ability to notify users when the hood is due for recertification and shall provide a visible notification at the LCD display stating “Fume Hood Certification is due or expired.”

M. Emergency (purge) exhaust
1. The display shall have a mechanical membrane button on the lower portion that when pressed will initiate an emergency (purge) exhaust mode in the attached fume hood valve(s).
   a. Button shall be mechanical so that users with rubber, nitrile, vinyl, latex, or other gloves can operate the emergency exhaust button.
2. The emergency (purge) exhaust mode, when initiated, will send the attached fume hood exhaust valves to either the maximum flow of the valve, or other predefined flow (as configured in the fume hood valve).

N. Alarms
1. The device shall have the ability to show alarms on the main screen using visual and audible alerts.
2. The main screen background color shall change to flashing red with text stating the type of alarm.
3. In alarm state, the enunciator shall remain active until the event that triggered the alarm is removed or fixed.
4. The device shall have the ability to show Diversity alarm.
   a. Diversity alarm shall be generated by the valve or from the BMS system.
   b. No audible tone for diversity alarm shall be generated at the fume hood display.
5. The device shall have the ability to have customizable audible alarms levels and customizable mute duration.
6. Users shall have the ability to change the volume of the alarm tone to low, medium, or high.
7. The device shall have an Alarm Muting option, which silences the audible alarm for an adjustable time period when the mute button is pushed. If another alarm is generated during the mute period, the new alarm shall override the mute delay and the alarm shall sound again.
8. The alarm tone shall be cleared only when the event that triggered the alarm is removed or fixed.

O. Energy conservation
1. The device shall have the ability to enable fume hood hibernation mode.
   a. When activated the exhaust flow through the fume hood goes to the minimum allowed by the exhaust valve (or shut-off where available) when the sash is fully closed and no chemicals are present in the hood.
   b. The mode shall be initiated by a sequence including entering menu and a password on the touch display, an external momentary switch input to the fume
c. When activated, the LCD display shall show “Hood in Hibernation,” and the
exhaust valve shall move to its minimum position or shutoff position.
d. Safety shall be built into the decommission option, whereby opening the fume
hood sash shall automatically return the fume hood exhaust to an in-use
operating volume as determined by the sash sensor. Fume hood hibernation
shall be a point that can be integrated to the BMS or BAS system.

2. The device shall provide night time energy waste alarming to generate a visual and
audible alarm to notify when the fume hood sash is open beyond its minimum flow
position and the lights in the room are off.
a. When activated, the LCD display shall show “Energy Waste Close Sash” and
the audible alarm shall sound until the sash is closed.
b. The light levels at which the alarm is both initiated and cancelled shall be
configurable.

3. The device shall provide sash energy waste alarming, which generates a visual and
audible alarm to notify when the fume hood sash is open beyond a configurable set
position and no one is in front of the fume hood.
a. When activated, the LCD display shall show “Energy Waste Close Sash” and
the audible alarm shall sound until the sash is closed.

P. Security
1. End users shall have the ability to enable a PIN pass code to prevent unauthorized
changes to sash heights, air flow settings and other editable parameters.

Q. Compliance
1. The unit shall be certified as meeting regulatory compliance with CE, CUL, and RoHS.
2. The unit shall be suitable for use with non-solvent wipe down and is designed to meet
IP44 test standards.
3. The device shall comply with part 15 of the FCC Rules. Operation is subject to the
following two conditions:
4. This device shall not cause harmful interference.
5. This device shall accept any interference received, including interference that may
cause undesired operation.

R. Environment
1. The operating temperature range shall be between 32 – 122°F (0 – 50°C).

2.3 ACCEPTABLE MANUFACTURERS

A. Manufacturer List
1. The plans and specifications for the LACS are based on systems and equipment
manufactured by Phoenix Controls Corporation, Price Industries Limited, and Accutrol
LLC.

B. Substitute Limitations
1. In strict accordance with this specification, alternative LACS and equipment listed
above shall only be considered for approval provided that the equipment be equal in
every respect to the operational characteristics, capacities and intent of control
sequences specified herein. Approval to bid does not relieve the LACS supplier from
complying with the minimum requirements or intent of the construction documents, both
drawings and specification.

2. Only those systems specifically named in this specification or by addendum shall be
considered for approval. LACS supplier shall provide a separate compliance schedule,
which shall include the section, paragraph and subparagraph of these specifications,
and a direct statement to indicate compliance or noncompliance with the requirements.
For all areas of noncompliance, the supplier shall describe what specific and alternative
approach or approaches has been taken and document the impact this will have on the
sizing of the air delivery systems (ductwork and air valves), the required cooling and heating capacities, energy costs and maintenance of the building.

2.4 PERFORMANCE/DESIGN CRITERIA

A. Each laboratory shall have a dedicated LACS. Each dedicated LACS shall support a minimum of 20 network controlled airflow devices.

B. The LACS shall employ individual average face velocity controllers that directly measure the area of the fume hood sash opening and proportionally control the hood’s exhaust airflow to maintain a constant face velocity over a minimum range of 20% to 100% of sash travel. The corresponding minimum hood exhaust flow turndown ratio shall be 5 to 1.

C. The hood exhaust airflow control device shall respond to the fume hood sash opening by achieving 90% of its commanded value within one second of the sash reaching 90% of its final position (with no more than 5% overshoot/undershoot) of required airflow. Rate of sash movement shall be from one to one and one-half feet per second.

D. The hood exhaust airflow control device shall be switched automatically between in-use and standby levels based on the operator’s presence immediately in front of the hood. A presence and motion sensor shall activate the switching. The airflow control device shall achieve the required in-use commanded value in less than one second from the moment of detection with no more than a 5% overshoot or undershoot.

E. The LACS shall maintain specific airflow (±5% of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change, airflow change or quantity of airflow control devices on the manifold (i.e. within 0.6" to 3.0" wc).

F. The LACS shall use volumetric offset control to maintain room pressurization. The system shall maintain proper room pressurization polarity (negative or positive) regardless of any change in room/system conditions, such as the raising and lowering of any or all fume hood sashes or rapid changes in duct static pressure. Systems using differential pressure measurement or velocity measurement to control room pressurization are unacceptable.

G. The LACS shall maintain specific airflow (±5% of signal) with a minimum turndown as specified in section 2.2 ensure accurate pressurization at low airflow and guarantee the maximum system diversity and energy efficiency.

H. Airflow Control Sound Specification
   1. The LACS manufacturer shall provide comprehensive sound power level data for each size airflow control device. All data shall be obtained from testing in accordance with ASHRAE/ANSI Standard 130, Methods of Testing Air Terminal Units.
   2. All proposed airflow control devices shall include discharge, exhaust and radiated sound power level performance.

2.5 OPERATION SEQUENCES

A. The airflow control devices shall utilize peer-to-peer, distributed control architecture to perform room-level control functions. Master-slave control schemes shall not be acceptable. Control functions shall include, at a minimum, volumetric offset pressurization, temperature, humidity control, as well as respond to occupancy and emergency control commands.

B. Volumetric Offset Pressurization Control The laboratory control system shall control supply and auxiliary exhaust airflow devices in order to maintain a volumetric offset (either positive or negative). Offset shall be maintained regardless of any change in flow or static pressure (within specified range for medium or low pressure valves). This offset shall be field adjustable and
represents the volume of air, which will enter (or exit) the room from the corridor or adjacent spaces.

C. The pressurization control algorithm shall sum the flow values of all supply and exhaust airflow devices and command appropriate controlled devices to new set points to maintain the desired offset. The offset shall be adjustable as a configurable parameter in the LACS as set by startup technician or BMS/BAS.

D. The pressurization control algorithm shall consider both networked devices, as well as: Up to three non-networked devices providing a linear analog flow signal. Any number of constant volume devices where the total of supply devices and the total of exhaust devices may be factored into the pressurization control algorithm.

E. Volumetric offset shall be the only acceptable means of controlling room pressurization.

F. The volumetric offset control algorithm shall support the ability to regulate the distribution of total supply flow across multiple supply airflow control devices in order to optimize air distribution in the space.

G. Temperature Control
   1. Standard Primary Temperature Control: The laboratory control system shall regulate the space temperature through a combination of volumetric thermal override and control of reheat coils and/or auxiliary temperature control devices. The laboratory control system shall support up to four separate temperature zones for each pressurization zone. Each zone shall have provisions for monitoring up to five temperature inputs and calculating a straight-line average to be used for control purposes. Separate cooling and heating set points shall be writeable from the BMS, with the option of a local offset adjustment. Temperature control shall be implemented through the use of independent primary cooling and heating control functions, as well as an auxiliary temperature control function, which may be used for either supplemental cooling or heating. Cooling shall be provided as a function of thermal override of conditioned air with both supply and exhaust airflow devices responding simultaneously so as to maintain the desired offset. Heating shall be provided through modulating control of a properly sized reheat coil.

   2. Auxiliary Temperature Control: The auxiliary temperature control function shall offer the option of either heating or cooling mode and to operate as either a standalone temperature control loop, or staged to supplement the corresponding primary temperature control loop.

H. Humidity Control
   1. The laboratory control system shall have an embedded humidity control function, which allows the monitoring and control of the relative humidity level in the pressurized zone. Using peer-to-peer control, the airflow devices shall have the ability to monitor the relative humidity level of the space and, based on a BMS writeable set point, develop a control signal to drive one or the other humidification or dehumidification control circuits. The humidity control loop(s) shall share a common set point, with a configurable deadband adjustment to prevent the humidification and dehumidification control functions to operate at the same time.

I. Occupancy Control
   1. The laboratory control system shall have the capability to change the minimum air change and/or temperature control set points, based on the occupied state, in order to reduce energy consumption when the space is not occupied. The occupancy state may be set by either the BMS as a scheduled event or through the use of a local occupancy sensor or switch. The laboratory control system shall support a local occupancy override button that allows a user to override the occupancy mode and set the space to occupied for a predetermined interval, if needed. The override interval shall be
configurable from one to 1440 minutes. The local occupancy sensor/switch or bypass button shall be given priority over a BMS command.

J. Emergency Mode Control
1. The laboratory control system shall provide a means of overriding temperature and pressurization control in response to a command indicating an emergency condition exists, and airflow control devices are to be driven to a specific flow set point. The system shall support up to four emergency control modes. The emergency control modes may be initiated either by a local contact input or BMS command. Valve level emergency modes can be individually programmed on each valve as one of four emergency control modes. Zone level emergency modes will drive supply and exhaust valves to maintain or ignore zone offset (excludes control of hood valves).
2. Once an emergency mode is invoked, pressurization and temperature control are overridden for the period that the mode is active. Emergency modes shall have a priority scheme allowing a more critical mode to override a previously set condition.

K. Local Alarm Control
The laboratory control system shall provide the means of summing selective alarm activity at the room-level network and generating a local alarm signal. The local alarm signal may be directed to any available output, as well as to the BMS. The alarm mask may be configured differently for each room-level system.

L. Shut-off Control
1. The laboratory control systems shall provide means of commanding air flow devices to shut-off sequence in one of three modes.
2. The shut-off sequence can be initiated locally through a universal input or remotely from the BMS or other controller such as Local Display Unit (LDU) using emergency mode(s). Fume hood air flow devices cannot be controlled locally using a universal input.
3. The shut-off sequence can be initiated on a fume hood air flow device using hibernation mode in conjunction with a FHM631 fume hood monitor in one of three methods: local contact closure, pushbutton sequence using faceplate of fume hood monitor, or remotely via BMS.
4. The shut-off sequence can be initiated on a general exhaust (Gex) air flow device in a lab environment when the total non-Gex exhaust air flow satisfies minimum air change rate and cooling demand for a period greater than 60 seconds. Shut-off must be enabled on the general exhaust air flow device.

M. Diversity Alarm
The laboratory control system shall have the ability of monitoring the airflow values for the pressurized space and generating an alarm signal in the event the total exhaust flow exceeds a predetermined threshold. The diversity alarm is intended to allow the user to take diversity in the design and generate an alarm condition in the event the diversity threshold is compromised. This function must be available in either an integrated or standalone system.

N. Fume Hood Control
Airflow devices intended to control the face velocity of a fume hood shall have the ability to interface directly with the fume hood monitoring device. The airflow control device shall:
1. Accept command inputs to regulate the flow accordingly and make this command value available to the BMS.
2. Accept a sash position signal and make this value available to the BMS.
3. Accept a Zone Presence Sensor (ZPS) Usage Based Control signal to indicate user presence and make this signal available to the BMS.
4. Provide a flow feedback signal to the fume hood monitor, which may be used for calculating face velocity or to confirm the airflow device has achieved the proper flow rate and make this value available to the BMS.
5. Provide alarm signals to the fume hood monitor in the event the airflow device is unable to achieve the proper flow rate, there is a loss of static pressure indicating improper fan operation, or there is a loss of power to the airflow control device, in order to provide a
local alarm indication. The fume hood airflow control device shall respond to changes in sash position and user presence within one second without hunting, in order to provide a constant 100-feet-per-minute face velocity when the fume hood is in use.

O. The laboratory control system shall be segregated into subnets to isolate network communications to ensure room-level control functions and BMS communications are carried out reliably. Each laboratory space or pressurization zone shall be its own subnet.

P. The LACS shall support at least 20 networked devices in each pressurized zone.

Q. All points shall be available through the interface to the BMS (BAS) for trending, archiving, graphics, alarm notification and status reports. LACS performance (speed, stability and accuracy) shall be unaffected by the quantity of points being monitored, processed or controlled.

R. Refer to the BMS (BAS) specification section 15980 for the required input/output summary for the necessary points to be monitored and/or controlled by BAS.

2.6 INTERFACE TO BUILDING MANAGEMENT SYSTEMS

A. The LACS network shall have the capability of digitally interfacing with the BMS. The required software interface drivers shall be developed and housed in a dedicated interface device furnished by the LACS supplier.

B. All room-level points shall be available to the BMS for monitoring or trending as shown in Table 1. Below. The LACS Room Controller, Room Integrator, Room Manager, or Supervisor shall maintain a cache of all points to be monitored by the BMS. The room-level airflow control devices shall update this cache continually.

C. The Room-level network shall be BACnet or LonTalk FTT-10A communications protocol.

D. Room Level Integration:

1. Valves shall be provided with room Level Integration device. Room Level Integration device shall be a standalone piece of hardware with embedded Power PC platform (@400MHz or greater), operating on QNX Real-time Operating system and will be used for commissioning and configuration of Venturi valves and ancillary components such as Fume Hood Displays, and Input Output (I/O) modules when connected to a Phoenix Controls Workbench, Room Manager, or Supervisor.

2. After the Room Level Interface is commissioned it shall provide a web based user interface for device, network, and platform diagnostics as well as a Test and Balance web application for zone balance and airflow validation. Room Level interface will also provide a means of integrating on an open BACnet network via IP, Ethernet, or MS/TP to be field selectable at time of commissioning.

3. Room Level Integration device shall operate with the following platform and Operating system:
   a. Platform
      1) Power PC 405EX 400MHz or greater processor
      2) 256 MB SDRAM & 128 MB or greater Flash Memory
      3) Data Recovery Services with SRAM
      4) Real-time clock
   b. Operating System
      1) QNX RTOS
      2) Oracle Hotspot JAVA VM
      3) Niagara AX 3.7.106 or later
      4) Niagara 4.0 Ready

4. Room Level Integration device shall support a combination of the following network
connection ports and communication protocols as standard or orderable options:

a. 2 Ethernet Ports (RJ-45 Connectors) – 10/100 Mbps
b. 1 RS-232 Port (9 pin D-shell connector)
c. 1 RS-485 on board port (3 Screw Connector on base board)
d. 2 Dual port RS-485 expansion adapters
e. 2 LON adapters 78 Kbps FTT 10
f. BAS protocol: BACnet over Ethernet, or BACnet over IP, or BACnet over MS/TP
g. BAS Implementation: Conformance Class 3 BIBBS-BBC (BACnet Building Controller)
h. BAS data transfer rates (points per second): Read requests – 50 sustained, 100 peak; Write commands – 30 maximum
i. Room network: ANSI 709.1 LonTalk protocol

5. Each LON FTT-10A adapter on the Room Level interface shall support up to 20 Phoenix Controls Digital High Speed Celeris controllers with Digital Sentry Fume hood monitors (when needed for fume hood operation), or 20 Phoenix Controls Traccel or Theris tracking pair digital standard speed controllers (total of 40 LON FTT-10A Celeris devices combined when two LON FTT-10A channels are installed)

6. Room Integrator (RMI300) device shall have option to be field upgraded to a Room Controller

7. (RMC300) to support pluggable local Input/Output (I/O) modules with the following options:
   a. 16-Point Module
      1) 8 Universal Inputs (Type 3 (10 k) Thermistors, 0 - 1000 ohms, 0 - 2) 10 volts, 0 - 20 mA with external resistor
      3) 4 Relay Outputs (Form A contacts, 24 VAC @ 0.5 amp rated)
      4) 4 Analog Outputs (0 - 10 VDC)
   b. 34-Point Module
      1) 16 Universal Inputs (Type 3 (10 k) Thermistors, 0 - 1000 ohms, 0 - 2) 10 volts, 0 - 20 mA with external resistor
      3) 10 Relay Outputs (Form A contacts, 24 VAC @ 0.5 amp rated)
      4) 8 Analog Outputs (0 - 10 VDC)

8. If the room level integration device drops off the network or loses power, it shall not cause the zone balance, temperature control, or fume hood devices to lose control. The room level valve devices should operate independently of the room level integration device.

9. Room Level Integrator shall be able to Integrate to BAS shall be through BACnet/IP, BACnet/Ethernet, BACnet MS/TP through on board communication adapters and shall be field configurable/upgradable.

E. Points List
   Table1. Typical Integration Points List

<table>
<thead>
<tr>
<th>Point Description</th>
<th>Read/Write</th>
<th>Point Description</th>
<th>Read/Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve-Level (per Valve)</td>
<td>Read/Write</td>
<td>Temperature Control (per Zone)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>Flow Set Point</td>
<td>Read Only</td>
<td>Space Temperature</td>
<td>Read Only</td>
</tr>
<tr>
<td>Flow Feedback</td>
<td>Read Only</td>
<td>Avg Space Temperature</td>
<td>Read Only</td>
</tr>
<tr>
<td>Jam Alarm</td>
<td>Read Only</td>
<td>Discharge Air Temperature</td>
<td>Read Only</td>
</tr>
<tr>
<td>Flow Alarm</td>
<td>Read Only</td>
<td>Duct Temperature</td>
<td>Read Only</td>
</tr>
<tr>
<td>User Definable inputs/Outputs</td>
<td>Read/Write</td>
<td>Temperature Set Points (9)</td>
<td>Read/Write</td>
</tr>
<tr>
<td>User Definable Alarm Points</td>
<td>Read Only</td>
<td>Effective Temperature Set Point</td>
<td>Read Only</td>
</tr>
</tbody>
</table>
F. LACS critical environment integration shall support distributed network architecture from room level BACnet MS/TP segment or LON FTT-10 bus to a dedicated BACnet MS/TP segment, building BACnet/Ethernet, or BACnet/IP building backbone using single or multiple IP addresses. Backbone communication protocol must be field selectable/upgradable.

G. Communication between devices in a room or zone will operate independent of building level communications maintaining integrity of the airflow. LACS Building level communication, or loss of, will not disrupt the communication between devices in a room or zone.

H. LACS critical environment integration shall provide an easy means to access room level device health status at a room-by-room or building wide level via web page. The system health pages shall provide information to assist in diagnostics for:
1. Online/Offline status for the room level integration appliance.
2. Runtime information such as heap memory usage and CPU usage.
3. Communication channel online/offline and configuration data.
4. Device level online/offline information.
5. Device level alarm information.
6. Device level Configuration errors.

I. LACS critical environment integration shall provide an easy means to access a Test and Balance function tool at a room-by-room or building wide level via web page. Test and balance functions should include:
1. Setting the devices in the room to various conditions in order to read airflow.
2. Manually override the outputs for testing purposes.
3. Adjust airflow to meet field acceptance tests.

J. LACS critical environment integration must be able to support SQL database for long term data storage.

K. LACS critical environment integration shall provide optional software to manage local backup and restore, entire site device management, building wide test and balance functions, building wide diagnostic tools, and building wide configuration tools. Software shall be field upgradable to support graphical dashboard displays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The building management system (BMS) or building automation system (BAS) contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the LACS supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels or use of fixed sash sensors with take up reels is also permitted. Sash interface boxes with interface cards shall be mounted in an accessible location.

B. The BMS contractor shall install all Room Controllers and Room Integrators in an accessible location in or around the designated laboratory room.

C. The BMS shall install an appropriately sized and fused 24 VAC transformer suitable for NEC Class II wiring.

D. All cable shall be furnished and installed by the BMS contractor. The BMS contractor shall terminate and connect all cables as required. The BMS shall utilize cables specifically recommended by the laboratory airflow controls supplier.

E. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.

F. The mechanical contractor shall provide and install all reheat coils, and transitions.

G. The mechanical contractor shall provide and install insulation as required.

H. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

3.2 SYSTEM START UP

A. System start-up shall be provided by a factory-authorized representative of the LACS manufacturer. Start-up shall include calibrating the fume hood monitor and any combination sash sensing equipment, as required. Start-up shall also provide electronic verification of airflow.
(fume hood exhaust, supply/make-up, general exhaust), system programming and integration to BMS/BAS.

B. The balancing contractor shall be responsible for final verification and reporting of all airflows.

3.3 CLOSEOUT ACTIVITIES

A. Training
1. The LACS supplier shall furnish a minimum of eight hours of owner training by factory trained and certified personnel. The training shall provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves and general troubleshooting procedures.
2. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

END OF SECTION
SECTION 15945
BUILDING COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the contract, including general and supplementary conditions, and Division 1 specification sections, apply to this section.

1.2 SYSTEMS TO BE COMMISSIONED/TASKS:

A. General: The systems to be commissioned shall include the following:
1. Division 15 Systems
2. Division 16 F/A system (Duct Detectors, Fire Smoke Dampers)

B. Mechanical Systems: Provide functional performance testing for all modes of operation for all mechanical equipment included in the design. The “as applicable” caveat is intended to exclude any generically listed pieces of equipment that are not included in the design.
1. Hydronic Flushing
   a. Provide on-site attendance and witnessing of all flushing procedures by the mechanical contractor. Provide sufficient time for witnessing flushing procedures.
   b. Assist and advise the contractor in completion of the flushing according to the specified and Owner required flushing procedures.
2. Air Conditioning Systems including:
   a. Fans
   b. VFD’s
   c. Dampers
   d. Heating coils
   e. Cooling coils
   f. Room zone verification to verify correct sensor vs air valve damper zoning.
   g. Ventilation
3. Terminal Units (as applicable) including:
   a. Variable volume air Valves (supply and exhaust) and Reheat Coil units
   b. Miscellaneous coils.
4. Exhaust and Supply Systems:
   a. General
   b. Fume Hood Exhaust
   c. Rack exhaust (constant volume)
5. Facility Control System (Building Automation) including
   a. Analog sensor calibration verification
   b. Start/stop, status and alarm verification
   c. Analog output scaling and device operation verification.
   d. Sequence of operation testing for all modes of operation for all seasons including review of software.
   e. Verification of MSIP graphics, point display, point command, alarming and BACnet interface database verification, interoperability performance.
   f. Testing of the FCS shall occur in a timely manner to meet the construction schedule. If required, testing shall occur without the MSIP graphics to meet the construction schedule.
C. Life Safety Systems:
1. Fire Alarm System: Review test documentation; verify installation and operation of all required devices. Coordinate the verification walkthrough of the local Authority Having Jurisdiction. Observe initiation of each typical initiation device.
2. Duct Detectors: Test and certify the duct smoke detectors are installed and performing within the manufacturers requirements. Provide testing sheets for each detector. Provide all detector manufacturers performance data and verification that the location provides sufficient air velocities under all modes of operation to meet this data. In addition, verify the detector operation to verify appropriate shut down sequences.

1.3 WORK DESCRIPTION:

A. General:
1. Commissioning is a systematic process of providing documented confirmation that the tested building systems function in compliance with criteria set forth in the Project Documents to satisfy Building’s operational needs. The commissioning process shall coordinate what have traditionally been separate functions of system documentation, equipment startup, control system calibration, testing and balancing, and performance testing.
2. The Commissioning described herein, is not intended to supersede or replace the normal system startup by the contracting team, observations by the design team or balancing by the test and balance contractor.
3. Commissioning Process: All commissioning shall be performed concurrently with construction such that commissioning is approximately 95% complete prior to substantial completion acceptance and systems demo, and 100% complete prior to final acceptance. This is intended to:
   a. Reduce as much as possible any duplication of work or testing for the Contractor.
   b. Identify and solve any potential mechanical system design or construction problems as they relate to functional performance, prior to opening day.

B. Commissioning Team:
1. The commissioning team shall be made up of the:
   a. Commissioning Authority
   b. Representatives of the Owner,
   c. Design Consultants
   d. Construction Trades including major equipment suppliers.
2. The trades represented on the commissioning team will include:
   a. Prime Contractor
   b. Mechanical Contractor
   c. Electrical Contractor
   d. Building Management System Contractor
   e. Fire Alarm System Contractor
   f. Test, Adjust and Balancing Contractor
3. The lead tradesman for each trade who will actually perform or supervise the commissioning work is to be designated as the representative to the commissioning team.
4. Responsibility for various steps of the commissioning process will be divided among the members of the commissioning team, as described in this section.

1.4 DEFINITIONS:

A. Definition of Terms:
1. Adjustment: To change the speed, flow, position, signal, or level of any piece of mechanical equipment.
2. Calibration: To check or adjust the graduations of a quantitative measuring instrument against a known standard.
3. **Datalogging** - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.

4. **Deficiency** - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not comply with the design intent).

5. **Design Intent** - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

6. **Facility Control System (FCS)**: Other common acronyms are DDC (Direct Digital Controls), BAS (Building Automation System), BMS (Building Management System) or FMS (Facility Management System). This is the system providing automation functions for control of the HVAC and mechanical systems as well as alarming, monitoring, trending and interface/integration to related building systems such as fire alarm, security, card access, electrical switchgear, and stand-alone controls for major equipment such as chillers.

7. **Functional Performance Testing (FPT)**: This portion of the Commissioning Process involves dynamic tests that ensure that all mechanical systems function in accordance with design intent. The tests are dynamic and on-line and test the systems through all possible modes of operation.

8. **Installation Verification**: This initial portion of the Commissioning Process includes observations and punch-lists recorded and performed by the Engineer to ensure that all equipment is installed in accordance with the Specifications and Drawings. The Commissioning Authority shall overview this process.

9. **Minor Adjustment**: To add, subtract, or change various parameters included in the operation logic of a mechanical system or systems in order to improve or optimize operational performance. This refers only to the specified performance logic. Difficulties encountered in accomplishing a minor adjustment shall not be used to define a minor versus a major adjustment.

10. **Major Adjustment**: To fully change the specified operation logic of a mechanical system or systems. This refers only to the specified performance logic. Difficulties encountered in accomplishing a minor adjustment shall not be used to define a minor versus a major adjustment.

11. **Pre-functional checklists (PFC)**: This portion of the Commissioning Process involves primarily the test and balance and startup personnel to ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers’ requirements. This is documented with a pre-functional checklist provided and completed by the contractor. The Commissioning Authority shall overview this testing.

12. **Statistical Sampling** - Functionally testing a statistically representative quantity (i.e. 15%) of identical or near identical pieces of equipment. Subject to 3% failure threshold whereby if there are greater than 3% testing failures of randomly chosen equipment, the testing shall be noted as failed and the Contractor shall re-verify the startup of 100% of the equipment. An additional identical statistically representative quantity of equipment shall again be tested which shall include a retest of 25% of the failed equipment and 75% randomly chosen untested equipment. This shall be repeated until the testing is noted as passing. Any proposed statistical sampling shall be identified in the construction phase commissioning plan and approved by the CxA.

13. **System Component or System Element**: A single piece of mechanical equipment such as a pump, fan, chiller, boiler, coil, etc. that when combined together through piping or ductwork will comprise a "System".

14. **System**: A combination of system components that allow the manufacture or distribution of conditioned air or water from one location to another.

15. **Tuning**: To adjust for maximum performance.
1.5 QUALIFICATIONS:

A. The Commissioning Authority shall be contracted to an outside CxA. The process of commissioning as defined here-in goes well beyond typical HVAC system start-up both in detail of testing and in detail of documentation. The director of the commissioning process is the Commissioning Authority (CxA).

B. Commissioning Authority Qualifications:
1. The CxA shall have a documented experience specifically in building Commissioning.
2. Documentable experience in Commissioning Central Utility Plants and projects of similar size and scope.
3. Documentable experience in startup and troubleshooting HVAC, hot water heating, fire suppression, electrical, emergency power, fire alarm, and life safety systems of similar complexity to those contained in these documents.
4. A demonstrable working knowledge of complex environmental, fire alarm, electric power control and facility control systems; be capable of understanding control vendor’s operating system and control code; be capable of troubleshooting control code and recommending necessary modifications.
5. Provide resumes of individuals dedicated to project Commissioning.
6. Competency in system design and intent.
7. Knowledge of the test and balance of air and hydronic systems.
8. Excellent communication and writing skills, organizational skills, and ability to work well with management and trades contractors.
9. The Commissioning company shall not be directly or indirectly financially involved with any or the design or construction companies participating in the project.
10. The CxA office shall be a full member of the Building Commissioning Association.
11. The Commissioning personnel shall not be the project superintendent, foreman, safety officer, MEP coordinator or hold other duties that would keep him/her from fulfilling the responsibilities of Commissioning Authority.

C. SUBMITTALS:
1. Commissioning Plan – Construction Phase: Within 30 calendar days of notice to proceed, submit a preliminary construction phase commissioning plan to identify how commissioning activities will be integrated into general construction and trade activities. The plan is the key means for the CxA to inform all parties as to how each system functions, independently and with respect to other systems. The plan shall be updated regularly and redistributed to the commissioning team for review and comment. The intent of this plan is to evoke questions, expose issues, and resolve them with input from the entire commissioning team early in construction. The commissioning plan shall identify how commissioning responsibilities are distributed. Include the following sections:
   a. Executive Summary: Provide a description of the Commissioning Manual
   b. Commissioning Team: Provide a listing of all commissioning team members including the names, addresses, and office/fax/cell phones number, commissioning authority, architect, mechanical engineer, electrical engineer, general contractor, mechanical contractor, electrical contractor, controls contractor, fire alarm system contractor and test & balance contractor.
   c. System Overview: Provide a listing of design weather data, design parameters and all commissioned system equipment data.
   d. Overview of Testing Program Procedures: Provide a detailed description of the testing plan and procedures that will be implemented during the commissioning process.
   e. Record Document - Sequences of Operation: Provide a detailed sequence of operation that is utilized for testing purposes. The final commissioning report shall describe any modifications to the engineer specified sequences of operation.
f. Pre-Functional Testing Checklists: Provide prefunctional testing checklist forms to the contracting team for each individual piece of mechanical equipment. The forms shall describe all events required to fully start-up a piece of equipment.
g. Functional Testing Procedures & Data Forms: Provide complete and detailed functional performance testing procedures required to fully test the entire system including the following:
   1) Identify which subcontractors will participate in each of the tests.
   2) Identify instrumentation required for each test.
   3) Identify who will provide instrumentation for each test.
   4) Operational description: This shall include, for example, the design criteria, design intent/basis of design, code requirements, specifics of the equipment to be provided, sequences of operation, operating priorities, protocols, etc. Some of these items will be provided to the CxA with the construction package and may be copied or referenced.
   5) Each procedure shall have a unique alphanumeric designator consisting of the applicable functional performance test procedure designator followed by a dash digit suffix to distinguish multiple repetitions of the same procedure.
   6) The same procedure may be applied to multiple identical pieces of equipment or systems.
   7) Procedures shall reference the applicable specification section upon which the procedure is based.
   8) Identify the value for all setpoints and inputs, positions of adjustable devices, valves, dampers, and switches.
   9) Identify the range of acceptable results for each condition tested.
  10) FPT procedures shall be detailed test instructions, written with sufficient step-by-step information to allow a test to be repeated under identical conditions with repeatable results.
   11) Include space to record: Description of the procedure; whether the form is for a retest of a failed procedure; identification and location of the equipment being tested; identification of instrumentation used by serial number; observed conditions at each step of the procedure; acceptable results as specified elsewhere; date of the test; names of technicians performing the procedure; name and signature of the CxA
h. Provide samples of commissioning forms including:
   1) Deficiencies and Issues Log: Provide a sample functional performance test deficiency report form. Include space to record: Associated functional performance test data form number; date of test; name of person reporting the deficiency; description of the observations associated with the failure of the test; cause of the failure, if apparent at the time of the test; date and description of corrective action taken; name and signature of person taking corrective action; and schedule for retest.
   2) Daily Log: Provide a blank log as an example.
   3) Meeting Minutes: Provide a blank log as an example.
i. Commissioning schedule: Submit within 90 calendar days of notice to proceed.
j. Test equipment identification list: For each instrument, sorted according to intended use: Manufacturer; model number; serial number; calibration certification; range; accuracy; resolution; and intended use.

1.6 COMMISSIONING RESPONSIBILITIES

A. Commissioning Authority
   1. General Tasks:
      a. Coordinate and manage the commissioning activities.
      b. Schedule, agenda and attendees of commissioning process.
c. Coordinate directly with each Sub Contractor with respect to their responsibility and contractual obligations as it relates to commissioning.
d. Obtain, assemble and submit commissioning documentation.
e. Attend all on-site commissioning and construction activities.

2. Commissioning Documentation Development Tasks:
a. Develop the commissioning plan and schedule.
c. Coordinate locations of all required test ports required for testing and commissioning of the systems, and coordinate the installation verification inspections with the Engineer.
d. Prepare and submit the Commissioning Reports.
e. Assemble and submit the final Commissioning Report.

3. Pre-Functional Testing Tasks:
a. Be present during portions of the start-up activities and pre-functional testing to assist and witness the execution of startup.
b. Monitor the performance of the Test, Adjust and Balance contractor. Provide random sampling or direct witnessing of 20% of TAB contractor’s work.

4. Functional Performance Testing Tasks:
a. Direct the functional performance testing. Provide testing of all systems to provide complete confidence in the systems. The tests will include the interaction between individual components, sub-systems and complete building systems under both normal and emergency power conditions.
b. Provide 100% functional performance testing on critical systems and statistical based functional performance testing on high quantity, less critical systems. Statistical based testing is a random testing of different components/systems and requires less than a 3% failure rate, or the entire system must be re-checked by the contractor. The breakdown is detailed on the list of included systems.
c. Enforce system compliance and recommend modifications to the system design that will correct or enhance the system performance.
d. Coordinate the owner witnessing of the tests.
e. Review the accuracy and calibration of any instrumentation utilized for the functional performance testing.
f. Track commissioning deficiencies until correction. Within each system, include one re-commissioning for any deficiencies. Additional re-commissioning time beyond scope of work will be tracked and reported to Architect.

B. Design Engineer Responsibilities:
1. The Design Engineer shall be responsible for the observations and checklists for the Installation Verification as defined in Part 2 of this specification.
2. Additional calculation and investigation of design adjustments needs by the Engineers as defined by the Commissioning Authority.
3. Participate in the resolution of potential design concerns as discovered during the commissioning process.

C. Contractor Responsibilities:
1. The Contractor shall be responsible for the Pre-functional Testing, a start-up procedure performed prior to balancing as defined in Part 2 of this specification.
2. The Contractor shall be responsible for providing any technical personnel required for physical operation, testing, and simulation of control sequences for each piece of controlled equipment as required by the Commissioning Authority during the Functional Performance Testing. This shall include chiller service personnel, boiler service personnel, the temperature control engineering and technical startup crew, mechanical contracting service personnel for miscellaneous mechanical equipment, and balancing contractor personnel. To the extent possible, these personnel will be scheduled.
3. Additional calibration and adjustment of the mechanical equipment included in each mechanical system for proper operation under actual operation as defined by the Commissioning Authority.

4. Additional testing, calibration, adjustment, tuning, and minor adjustments to the temperature controls system sequences for proper operation under actual operation as defined by the Commissioning Authority.

5. Additional testing, calibration and adjustment of the mechanical water and airflows of each mechanical system for proper operation under actual operation as defined by the Commissioning Authority.

PART 2 - COMMISSIONING PROCESS

2.1 SCHEDULE:

A. Commissioning schedule: Integrate functional performance testing and commissioning requirements into the master construction schedule. Commissioning scheduling is the responsibility of the Contractor.
   1. Prior to the beginning of start-up or functional performance testing activities, update the schedule of commissioning activities monthly.
   2. Two weeks prior to the beginning of start-up or functional performance testing activities, provide a detailed two-week look-ahead schedule. Thereafter, update the two-week look-ahead schedule weekly for the duration of commissioning for that construction phase. The two-week look-ahead schedule shall identify the date, time, beginning location, contractor personnel required, and anticipated duration for each startup or test activity.

B. Commissioning of systems shall proceed per the criteria established in the specific sections that follow, with activities to be performed on a timely basis. Commissioning of systems may proceed prior to final completion of systems. The CxA must be available to respond promptly to avoid delay to the CPM schedule.

C. Problems observed shall be addressed immediately, in terms of notification to responsible parties and actions to correct deficiencies.

2.2 COMMISSIONING MEETINGS

A. Scope Meeting: Early in the construction process, a commissioning scoping meeting involving all members of the commissioning team shall be held at a time and place designated by Architect/Owner. The purpose of the meeting will be to familiarize all parties with the requirements of the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. Progress Meetings:
   1. Prior to the beginning of start-up or functional performance testing activities, the CxA will hold commissioning meetings biweekly. These meetings may be held concurrently with the general construction meetings.
   2. Beginning two weeks prior to the commencement of start-up or functional performance testing activities, whichever is earlier, the CxA will hold commissioning meetings at least weekly. Thereafter, and for the duration of commissioning for that construction phase, commissioning meetings will continue to be held at least weekly. These meetings may be held concurrently with the general construction meetings.

C. The CxA may require additional meetings if the commissioning process appears to be behind schedule.
2.3 TEST EQUIPMENT

A. The Division contractor for the equipment tested provides all standard or proprietary testing equipment required to perform startup and initial checkout and required functional performance testing. The mechanical contractor of Division 15 is ultimately responsible for all standard or proprietary testing equipment for the Facility Controls System (FCS) in Division 15, except for equipment specific to and used by TAB in their commissioning responsibilities. The Division contractor provides two-way radios.

B. Include special or proprietary equipment, tools, software and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents in the base bid price to the Contractor and left on site, except for stand-alone data logging equipment used by the CxA.

C. The CxA will provide data logging equipment and software required functionally to test equipment.

D. Provide all testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Contract Documents. If not otherwise noted, the following minimum requirements apply:
   1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F.
   2. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

E. Calibrate all equipment according to the manufacturer’s recommended intervals and when dropped or damaged. Affix calibration tags or have certificates readily available.

2.4 SYSTEM START-UP AND TESTING

A. General Requirements:
   1. All systems and system components shall be tested in presence of Commissioning Authority (and the Engineer if desired by the Engineer) to demonstrate compliance with specified requirements. To minimize the time of commissioning, contracting and engineering team members, testing shall be done in seasonal single blocks of time insofar as possible.
   2. The Contractor shall notify the Commissioning Authority fourteen (14) days prior to scheduled Functional Performance Tests, of the scheduled completion date of the Installation Verification and Pre-functional Testing.
   3. All testing shall be conducted under specified design operating conditions as approved by Commissioning Authority and Engineer.
   4. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by any inter-ties to other major systems.
   5. All special testing materials and equipment shall be provided by Contractor. This includes, but is not limited to proprietary equipment hand-held control parameter/setpoint adjustment tools and water/air flow balancing readout and adjustment tools.
   6. Provide one copy of all test reports and records to Commissioning Authority.

B. Test Procedure Development and Test Documentation:
   1. Within sixty (60) days prior to startup of the mechanical system, the Commissioning Authority shall prepare and submit to the Owners Representative and Engineer for review, descriptions of the test procedures which the Contractor will perform to demonstrate conformance of completed mechanical systems to the Plans and Specifications.
2. The decision of the Commissioning Authority and Engineer upon acceptability of test procedures shall be final. In the event of irresolvable conflict between decision of Commissioning Authority and Engineer, Engineer's decision shall have precedence. However, in no case shall such decision excuse the Contractor from fulfilling the requirements of commissioning as described in this Section.

C. Installation Verification Recommendations:
1. All systems and system components shall be checked and verified that they have been installed according to the drawings and specifications, and that all connections have been made correctly.
2. Each system of interactive system components shall be observed and verified that it is ready to function as specified.
3. Verification of complete and proper installation shall be completed prior to starting Component Performance Tests.
4. The Installation Verification shall be documented in a checklist format for each system/piece of equipment. Each checklist shall be dated and initialed by the Engineer.

D. Pre-functional Testing Requirements:
1. Each system component shall be checked for proper installation, shall be adjusted, and shall be calibrated to verify that it is ready to perform as specified.
2. All system components shall be checked to verify that they have been installed properly and that all connections have been made correctly. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence or other conditions which may cause damage.
3. Verify that test, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.
4. All discrete elements and sub-systems of system components shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.
5. Verification of complete and proper installation shall be completed prior to starting Functional Performance Tests.
6. The Pre-functional Tests shall be documented in a checklist format for each system and each piece of equipment. Each checklist shall be dated and initialed by the Contractor.

E. Functional Performance Testing Requirements:
1. A Functional Performance Test shall be performed on each complete system. Each function shall be demonstrated to satisfaction of the Commissioning Authority on a paragraph-by-paragraph basis of the written test procedure, developed to demonstrate conformance to requirements of contract Specifications and the Design Intent Document.
2. Each Functional Performance Test shall be witnessed and signed off by the Commissioning Authority and Contractor (and Owner=s Representative and Engineer if requested) upon satisfactory completion.
3. The Functional Performance Testing Program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.
4. The Commissioning Authority shall notify the owner, the contracting team, the architect, and the engineer at least two weeks prior to date of scheduled Functional Performance Tests. Schedule each of the seasonal Functional Performance Test periods over a single block of days. The schedule of the Functional Performance Tests shall be based on the construction completion schedule. Further communication to the owner, architect, or engineer concerning the Functional Performance Testing schedule and changes to that schedule due to construction delays or coordination conflicts shall not be required unless the noted parties have expressed an interest in writing in attending the testing.
2.5 COMMISSIONING REPORTS

A. Documentation - General:
   1. The Commissioning Authority shall record and maintain detailed testing data. The data record shall be comprehensive and concise.
   2. All data must be recorded as soon as possible during the course of the testing.
   3. All documentation shall have the date, time, and names of persons participating in the inspection and testing.
   4. All test instruments shall be documented for valid calibration.
   5. The recording work sheets, inspection check lists, and performance testing plans must all be approved by the Engineer and Commissioning Authority prior to the start of Functional Performance Testing.

B. Daily Commissioning Report Logs:
   1. The Commissioning Authority shall provide daily report logs to be included in the final report.
   2. The daily logs shall record the commissioning Authority personnel and event summaries of meetings, conversations, tests, failures, solutions, procedures and successes.

C. Installation verification audit: Prior to start-up, the CxA shall maintain a report of installation verification audit activities. Identify equipment and components verified, deficiencies noted, corrective action taken, and the dates and initials of the persons making the entries.

D. Start-up deficiency report: Within five days following start-up of each system or equipment, the CxA shall maintain start-up deficiency report forms. Identify systems and/or equipment started up, deficiencies noted, corrective action taken, and the dates and initials of the persons making the entries.

E. Test, adjust and balance (TAB) progress reports: After TAB activities have begun, the TAB shall submit weekly TAB progress reports to the CxA. Identify:
   1. Systems or subsystems for which preliminary balancing is complete.
   2. Systems or subsystems for which final balancing is complete.
   3. Status of deficiencies and balancing problems encountered, including corrective actions taken.
   4. Updated schedule of remaining TAB activities.

F. Deficiencies and Issues Report: At the end of each day, in which functional performance tests are conducted, the CxA shall maintain a deficiencies and Issues (D&I) log for tests for which acceptable results were not achieved during the day.
   1. Identify tests for which acceptable results were not obtained by test number and description, and equipment identification and location. Briefly describe observations about the performance that was associated with failure to achieve acceptable results. Identify the cause of failure if such is apparent.
   2. When corrections have been completed, the CxA shall update the functional performance test deficiency report forms. Identify corrective action taken and the dates and initials of the persons making the entries.
   3. Identify the schedule for re-testing.

G. Final Commissioning Report: The CxA shall prepare and submit a final report with the closeout package. The binding format shall be 8½ x 11 bound documents with 11 x 17 fold out. This report shall contain:
   1. The report shall verify performance of commissioned equipment and systems.
   2. Document any field modifications to the testing process and why these modifications were made.
   3. The organization of the final commissioning report shall be as follows:
PART 2 - COMMISSIONING

H. Hardcopy and Electronic Versions:
   1. The Commissioning Plan provided prior to the on-site commissioning and the Final Commissioning Report provided at the conclusion shall be provided in hard copy (3 copies) and electronic on CD (3 copies).
   2. The Commissioning Plan CD shall include files developed in the most current MS Word format.
   3. The Final Commissioning Report CD shall contain scanned copies of all documentation developed and gathered during the Commissioning Process in Acrobat PDF format.

PART 3 - EXECUTION

3.1 GENERAL

A. The Functional Performance Testing portion of the commissioning process shall begin after the installation of the HVAC equipment and systems, along with related equipment, systems, structures, and areas are complete.

3.2 COMMISSIONING PROCEDURE

A. Sequence of testing: Commissioning shall proceed from lower to higher levels of complexity. For each discrete subsystem or system, testing at the lower level shall be completed prior to starting the next higher level of tests. In general, the order of testing from lowest to highest is:
   1. Static tests (such as duct leakage tests).
   2. Component functional performance tests (of motors, actuators, sensors, etc.) and startup.
   5. Intersystem functional performance tests.

B. Re-testing: The Contractor shall repeat, at no additional cost to Owner, the complete functional test procedure for each test for which acceptable results are not achieved. Repeat tests until acceptable results are achieved. The CxA shall track commissioning deficiencies until correction. Within each system, the CxA shall provide one re-commissioning for any deficiencies. For systems with large quantities of identical equipment, a statistical re-commissioning strategy shall be applied to retest 30% of the deficiencies. The tested systems will not be witnessed by Architect until acceptable results are achieved, documented, reviewed and accepted.

C. Correction of deficiencies:
   2. Corrections during functional performance tests are generally prohibited to avoid consuming the time of personnel waiting for the test, but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and corrective action can be completed in less than five minutes. If corrections are made...
under this exception, the failure shall be noted on the functional performance test data form. A new functional performance test data form, marked “retest”, shall be initiated after the correction has been made. The entire functional performance test procedure shall be repeated.

D. Delegated witnesses: Witnesses may be designated by Owner/Architect to observe the commissioning process. Witnesses shall provide no labor or materials in the commissioning process. The only function of the witnesses shall be to observe and comment on the progress and results of commissioning.

3.3 INSTALLATION VERIFICATION

A. During construction, assist the Contractor and coordinate the AE’s observation the work of the Contractor and subcontractors to ensure that all installations are being made in accordance with the intent of the contract documents.

B. If any work is found to be incomplete, inaccessible, incorrect, or non-functional, make note of deficiencies and correct the deficiencies before system start-up work proceeds.

3.4 PRE-FUNCTIONAL TESTING (SYSTEM START-UP)

A. Assist the Contractor in the development a start-up plan and deficiency list. Commence with system start-up after approval has been given to the start-up plan and the pre-functional checklists have been signed off by the Contractor and subcontractors. The CxA and/or delegated representative shall witness system start-up and list all system and equipment deficiencies noted during start-up. The Contractor shall take corrective action on all system deficiencies noted and demonstrate suitable system operation to the CxA.

B. Prepare start-up deficiency list forms to report deficiencies discovered in conjunction with system start-up. Start-up deficiency forms shall indicate the system being started up; the location and identification of the deficient equipment/material; date of observation; initials of the observer; observed deficiency; date of correction; initials of person making the correction; and corrective action taken.

C. Issue start-up deficiency report forms to the Contractor for corrective action. The Contractor shall advise the CxA when all start-up deficiency list items have been corrected.

3.5 TEST, ADJUST, AND BALANCE (TAB)

A. Assist the Contractor in the coordination the air and hydronic balancing. Advise the TAB firm when systems are complete and ready for balancing. Start TAB as early as possible following systems start-ups and component functional performance tests, in order to be essentially complete prior to system functional performance tests. Coordinate TAB activities with other construction schedule activities.

B. Verify the accuracy of the TAB work prior to commencing any FPT activities that may be adversely affected by improper balancing.

C. Spot check 10% of the TAB measured flows for all air and water flows. This may be accomplished by physically measuring those flows independently of the TAB or witnessing the TAB contractor’s measurement of the required quantity.

3.6 FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. The CxA shall develop as a part of the construction phase commissioning plan submittal, the functional performance test (FPT) commissioning procedures and documentation to be used. Personnel experienced in the technical aspects of each system to be commissioned shall be
enlarged if necessary to augment the expertise of the CxA. Include functional performance test procedures and functional performance test data sheets for each system based upon actual system configuration. Emphasis shall be placed on testing procedures that will conclusively determine actual system performance and compliance with the design.

B. The test procedures shall fully describe system configuration and steps required for each test, appropriately documented so that another party can repeat the tests with virtually identical results.

C. The FPT procedures must confirm the performance of systems to the extent of the design intent/basis of design and applicable code under which the project was permitted. When a system is accepted, Owner and Architect must be assured that the system is complete, works as intended, is correctly documented, and that the designated Owner staff is trained in the operation and maintenance of the system.

D. The majority of mechanical equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met. This could include adequate oil pressure, proof-of-flow, non-freezing conditions, maximum head pressure, etc. Functional performance test procedures shall demonstrate the actual performance of safety shutoffs in real or closely simulated conditions of failure.

E. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or installed via software. Functional performance test procedures shall demonstrate these interlocks.

F. The CxA shall inform appropriate subcontractors and vendors before commissioning is started as to what the test and expected results will be. Whereas some test results and interpretations may not become evident until the actual tests are performed, all participants should have a reasonable understanding of the requirements. The commissioning plan must address the requirements and be distributed to all participants involved with that particular system.

3.7 REVIEW SOFTWARE DOCUMENTATION

A. The CxA shall review vendor/contractor/Owner-provided detailed FCS software documentation. This includes obtaining FCS program documentation, a review of the programming approach, interface with other systems (such as lighting, fire alarm, security, emergency generator monitoring, sump pumps, and utility metering), and a review of the specific software routines as applied to this project. Discrepancies in programming approaches shall be resolved to provide Owner with the most appropriate, simple, and straightforward approach to software routines.
SECTION 15950
BUILDING AUTOMATION SYSTEM (BAS) GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.

B Section 15959 - BAS COMMISSIONING

C Section 15951 - BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

D Section 15952 - BAS OPERATOR INTERFACES

E Section 15954 - BAS COMMUNICATION DEVICES

F Section 15953 - BAS FIELD PANELS

G Section 15955 - BAS SOFTWARE AND PROGRAMMING

H Section 15980 - SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK

A Provide a complete and operational system to perform all sequences of operations stated in the Sequence of Operation Section.

B The BAS currently utilizes electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions. The BAS for this project shall consist of monitoring and control of systems listed below. Also reference the control drawings, the sequences of operation, and the points list.

C The systems to be controlled under work of this section basically comprise the new HVAC system consisting of laboratory air valves in Vivarium (addition) building, and new rooftop unit that serves this area. This addition building will be connected to existing Honeywell controls in WHI building.

D BAS contractor shall obtain necessary information from client to verify existing controls system in this building. All existing HVAC system in WHI building shall operate as-is.

1.3 PROCUREMENT

A The BAS, DDC, and communications components installed as work of this contract, shall be an integrated distributed processing system by Honeywell Controls.

1.4 QUALITY ASSURANCE

A Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years. Firms with experience in DDC installation projects with point counts equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer’s product, installer must demonstrate at least three
years prior experience with that manufacturer’s products. Sub-Contractors for installation of wiring, tubing, and conduit will not be allowed. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.

B Installer’s Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than three years from date of final completion on at least 3 projects of similar size and complexity. Submittals shall document this experience with references.

C Installer’s Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 2 projects of similar size and complexity.

D Installer’s Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.

1.5 CODES AND STANDARDS

A The following codes and standards are intended to apply to the project or installation as applicable. All references to codes and standards herein refer to the latest edition at the time of contract execution.

B American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
1. 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
2. 62.1 Ventilation for Acceptable Indoor Air Quality
4. 55 Thermal Environmental Conditions for Human Occupancy.

C Electronics Industries Alliance
2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
3. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications
10. EIA-852: Tunneling of Component Network Data over IP Channels

D Underwriters Laboratories

E NEMA Compliance
1. NEMA 250: Enclosure for Electrical Equipment
2. NEMA ICS 1: General Standards for Industrial Controls.
F   NFPA Compliance
1.   NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
2.   NFPA 70 National Electrical Code (NEC)

G   Institute of Electrical and Electronics Engineers (IEEE)
1.   IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
2.   IEEE 802.3: CSMA/CD (Ethernet – Based) LAN
3.   IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN
4.   IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems

1.6   DEFINITIONS

A   Acknowledged: The data is broadcast repeatedly until an acknowledgement is received. This type of service should be used for critical data using one to one bindings only. This type of service shall not be used for one to many bindings.

B   Adjustable (Adj): A characteristic of a control logic parameter such that it can be varied by the operator without downloading the program. See also initial value.

C   Analog Calibration Offsets: For all analog input measured variables with the exception of velocity pressure, there is a requirement to adjust the value measured by the hardware based analog input point to match the value reported by a certified test instrument. An analog calibration offset is a parameter that can be added or subtracted from the raw value measured by the sensor to produce a calibrated value that will be used by the control logic and reported to the operator workstations. The initial value of this parameter is set at zero and it is adjusted when the calibration process is executed. This adjustment is referred to as a single point calibration. These parameters are mandatory for all analog inputs except velocity pressure sensors (requirements for velocity pressure sensors are presented elsewhere). These offset values are configuration parameters and as such shall be written to EEPROM. It shall be possible to change the value of these parameters from a graphic page.

D   Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.

E   Application Programming Tool: A vendor unique software tool used to create applications for programmable controllers.

F   Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).

G   Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications.

H   BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135 current version including all annexes and addenda.

I   Bandwidth Utilization: The average utilization of the network capacity. Network loading is controlled by the use of event driven broadcast based data propagation and the use of appropriate binding services.
J Binding Services: When the network management tool within Niagara is used to establish a binding, the programmer selects one of three types of binding services:

1. **Unacknowledged**: The data being broadcast is sent one time and an acknowledgement of receipt is not required. This type of service shall be used for non-critical data where there is no significant impact should the receiving device have to wait for the next broadcast.

2. **Unacknowledged Repeated**: The data being broadcast is sent three times and an acknowledgement of receipt is not required. This type of service shall be used for most process control related data requiring timely receipt of the data.

3. **Acknowledged**: The data is broadcast repeatedly until an acknowledgement is received. This type of service should be used for critical data using one to one bindings only. This type of service shall not be used for one to many bindings.

K Binding: The association of an output network variable from one device to the input network variable of a second device. There are three types of bindings:

1. **One to One**: A single output network variable is bound to a single input network variable
2. **One to Many**: A single output network variable is bound to input network variables on multiple devices.
3. **Many to One**: Output network variables from multiple devices are bound to a single input network variable on a different device.

L Broadcasting: The propagation of data from a device to the control network. Software objects that broadcast data to the network shall include the following parameters:

M Building Automation System (BAS): The entire integrated energy management and control system.

N Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135-1995).

O Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.

P Configuration Parameter: An input network variable to a controller (nci) that is written to the EEPROM. Configuration parameters can be changed periodically from the HMI but are not changed routinely as a function of control logic.

Q Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).

R Control System Server (CSS): A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device. As the BAS network devices are stand-alone, the CSS is not required for communications to occur.

S Controller or Control Unit (CU): Intelligent stand-alone control panel. Controller is a generic reference and is a PCU.

T Client’s WAN: Reference to UNLV Information Technology network, used for normal business-related e-mail and Internet communication.

U Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic

V Enumerated SNVT: Not Applicable.

W Error Rate: A measurement of communication quality that assesses the number of defective
data packets as a percentage of the total number of data packets. Defective data packets are generally the result of poor installation practices or improper cable selection.

**X** Event Driven Communication: A term used to describe the propagation of data from a device to the network based on broadcasting rather than polling. The send on delta parameter is used to define the event and the data propagation is further controlled by the minimum and maximum send time parameters.

**Y** Free Topology: A data wiring topology that allows for loops, tees, y-connections etc. When this topology is used only one terminator of a specific design is required and allowable cable lengths are significantly reduced.

**Z** Functional Profile: A collection of variables required to define the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.

**AA** Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them (ASHRAE/ANSI 135-1995).

**BB** Hand Held Device (HHD): Manufacturer’s microprocessor based device for direct connection to a Controller.

**CC** Host-Based Controller: Not Applicable.

**DD** JACE: Java Application Control Engine

**EE** Local Supervisory LAN Interface Device (LANID): Device used to facilitate communication and sharing of data throughout the BAS and client’s WAN.

**FF** Media Access Control (MAC) hardware address that uniquely identifies each node of a network. Each different type of network medium requires a different MAC layer.

**GG** Managed Communication: Data transmission from a controller to a data manager, which re-broadcasts that data to a second controller. In some systems the data manager is referred to a Network Controller.

**HH** Manual Control: A concept where the operator from the operator workstation takes control of an end device and forces a specific position or state. From a software perspective, the value produced by the control logic is not allowed to affect the position or state of the end device. The manual mode and the desired manual position or states are parameters that are set by the operator.

**II** Many to One: Output network variables from multiple devices are bound to a single input network variable on a different device.

**JJ** Maximum Send Time Parameter: A parameter used to ensure the periodic update of network data. If a time period equal to the value of this parameter has expired without a broadcast of the variable, a re-broadcast of the current value shall be executed. See also send on delta and maximum send time parameter definitions.

**KK** Maximum Send Time: An adjustable parameter that defines the maximum time period between broadcasts of a software object’s data to the network. Should the value of a software object remain constant over an extended period of time, the value will be rebroadcast once every maximum time period.

**LL** Minimum Send Time Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an updated value shall not occur unless a time period equal to
the value of this parameter has expired. The expiration of the time period does not mandate a re-broadcast. See also send on delta and maximum send time parameter definitions.

**MM** Minimum Send Time: An adjustable parameter that defines a mandatory time period during which no broadcasting of data will occur. Once this time period has been exceeded without a broadcast, the send on delta parameter or the maximum send time parameter shall determine when a broadcast is initiated.

**NN** MSIP: Multi-system Integration Platform

**OO** MSIP Interface Device: Device used to facilitate communication and sharing of data between the BAS at the local level and the client’s EMS Department MSIP Web Supervisor via the client’s WAN.

**PP** Multiple Controller Integrated Control (MCIC): A concept where multiple controllers with I/O are used to control a single mechanical system such as an air handling unit. Under this concept the mechanical system is sub-divided into a collection of processes to be controlled such as the fan start stop circuit, the fan variable speed drive, the mixed air section, the cooling coil section etc. With this concept all primary measured variables and the end device associated with a single process along with the primary control logic for the process shall be contained within a single controller. Secondary data from one process that affects the control of another process may be sent from one controller to the primary controller controlling the process. When data is sent from one controller to another controller, broadcasting concepts as defined above must be used. If the data being received over the network only affects the general thermodynamic or psychometric performance of the process but does not have a significant effect on safety or equipment protection then unacknowledged repeated binding services shall be used. If the data being received over the network does have a safety or equipment protection impact, then acknowledged repeated binding services shall be used. In both cases peer to peer communication is mandatory. All of the controllers must be on the same channel. Managed communication shall not be used to move data between the multiple controllers.

**QQ** One to Many: A single output network variable is bound to input network variables on multiple devices.

**RR** One to One: A single output network variable is bound to a single input network variable

**SS** Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.

**TT** Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, and POTs.

**UU** Operator Workstation (OWS): The user’s interface with the BAS system via the internet or the Local Supervisory LAN. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.

**VV** Peer to Peer Communication: Data is broadcast from its origin and is received by the final device requiring the data without being received and retransmitted by a third device.

**WW** Polling Communication: The process by which a control device requests a network variable from a second control device at a specified interval. Polling communication is typically used to populate dynamic data on an active graphic page and for temporary or short term trending of data where the trend data is not stored at the controller level.

**XX** Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller
and for remote dial up connection.

YY Primary Control Unit (PCU): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems.

ZZ Repeater: A physical device used to connect two segments. A repeater does not filter any message traffic. A repeater does isolate physical problems such as short circuits to a single segment and is typically required to allow the use of additional devices or additional cable length.

AAA Router: A device that connects two or more networks at the network layer.

BBB Send on Delta Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an output variable shall not occur unless the output variable has changed by an amount equal to or greater than the value of this parameter and the minimum send time has expired since the last broadcast. See also minimum send time and maximum send time parameter definitions. For binary data the send on delta parameter is assumed to be a change of state. Logic to support the send on delta concept may be imbedded in the configurable structure of an output point or programmed as part of the logic.

CCC Send on Delta: An adjustable parameter that defines a requirement to broadcast when the data generated by the software object changes by an amount that exceeds this parameter’s value. For binary data, this parameter defaults to a change of state. The broadcast of data is initiated when this criteria and the minimum send time requirement have been met.

DDD Simple SNVT: A simple SNVT defines the format of a single piece of data. The definition of a simple SNVT in the master list of SNVTs will include the type of variable being measured (temperature, electric current, power etc.), the data type (signed integer, unsigned integer, floating point etc.), the data range, the resolution of the data and the engineering units.

EEE SQL: Standardized Query Language, a standardized means for requesting information from a database.

FFF Stand-Alone Controller: A stand-alone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A stand-alone controller may rely on other networked devices for time schedule inputs and trend data storage.

GGG Structured SNVT: A structured SNVT defines the format of a network variable that contains several different data elements. A simple SNVT or an enumerated SNVT may define each data element within a structured SNVT.

HHH Supervisory Logic: The concept of gathering performance data from multiple terminal units to determine if a specific condition exists within the family of terminal devices. Examples: Are any of the VAV terminals supported by a particular AHU operating the reheat processes? Is there an indication from any of the control zones that an occupant has requested the temporary operation of the air delivery system?

III Terminator: An electronic component that consists of a resistive and capacitive circuit specifically designed to enhance the quality of communications on a segment. On a bus topology, a terminator is connected to each end of a segment. For a channel consisting of two bus topology segments, a total of 4 terminators are required, one at each end of each segment.
JJJ Test Mode: A concept where the operator from the operator work-station can interrupt the flow of data from a sensor to the control logic and insert a mandatory test value or test state to be used by the control logic. The test mode and the desired test value or states are parameters that are set by the operator.

KKK Unacknowledged Repeated: The data being broadcast is sent three times and an acknowledgement of receipt is not required. This type of service shall be used for most process control related data requiring timely receipt of the data.

LLL Unacknowledged: The data being broadcast is sent one time and an acknowledgement of receipt is not required. This type of service shall be used for non-critical data where there is no significant impact should the receiving device have to wait for the next broadcast.

MMM XIF File: Not Applicable.

NNN XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.7 FUNCTIONAL INTENT

A Throughout Sections 15950 through 15980, the Sequences of Operation, and Section 15959, detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. However these will only be allowed with prior approval.

1.8 SUBMITTALS

A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.

B. Refer to Section 15959 for additional commissioning submittal requirements.

C. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows:
   1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD drawing (2002 version or later). All applicable ‘cross-reference’, font, and plot style files shall also be provided.
   2. Other Submittals: All other submittals shall be provided in Adobe PDF format.
   3. Media: Electronic submittals shall be included on a CD or DVD with each applicable submittal binder.

D Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.

E Product Data: Submit manufacturer’s technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.

F Shop Drawings: Submit shop drawings electronically in AutoCAD format (2002 version or later) for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Shop drawings shall contain the following information:
   1. System Architecture and System Layout:
a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, and gateways. Indicate network number, device ID, address, device instance, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.

b. Floor plan drawings locating all control units, workstations, servers, LAN interface devices, and gateways. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.

2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices.
   a. Include written description of sequence of operation; identify each major component (hardware and software) involved in the control scheme by its tag identifier. Show locations for all global measurement instruments for interior or exterior ambient conditions such as outside air temperature sensors, outside air humidity sensors, static pressure references, etc.
   b. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
   c. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 15955 for additional requirements.
   d. Label each control device with setting or adjustable range of control.
   e. Label each input and output with the appropriate range.
   f. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
   g. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers. This information shall also be summarized in comprehensive valve and damper schedules.
   h. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that is existing, factory-installed, and portions to be field-installed.
   i. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.

3. Graphics: Provide color printouts of all specified graphic files including equipment schematics, tabular equipment data and floor plates.
4. All sheets in the submittal shall be consecutively numbered.
5. Each sheet shall have a title indicating the type of information included and the HVAC system controlled.
6. Provide a Table of Contents listing sheet titles and sheet numbers
7. Legend and list of abbreviations

G As-Built Control Drawings: Provide and mount as-built shop drawings for all controlled systems and equipment. Drawings should be of sufficient size to be easily read. Locate as-built drawings as follows:
1. During construction, drawings may be placed in plastic sleeves and mount in the control panel. The final drawings shall be laminated and permanently mounted in the control panel.
2. For terminal units, print as-built drawings on adhesive-backed label and apply to controller enclosure or unit casing.

H Control Logic Documentation
1. Submit control logic program listings (for graphical programming, if the requirements below are met) and logic flow charts illustrating (for line type programs) to document the control software of all control units.
2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Graphic programs that provide simple blocks connected by multiple lines that are not specific in detail and easily understandable are not acceptable. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation with all requirements of the sequence provided in detail. Provide in detail all virtual and real points, variables, PID loops, reset blocks, switches, timers, high/low selectors, alarms, proofing modules, staging blocks, etc. to fully describe the sequence of operation.
3. Include written description of each control sequence.
4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
5. Sheets shall be consecutively numbered.
6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
7. Include Table of Contents listing sheet titles and sheet numbers
8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Div. 1.
9. This portion of the submittal may be submitted after approval of all hardware, but shall be provided prior to installation of the network controller.

I Operation and Maintenance Materials:
1. Submit documents under provisions of Div. 1. In addition, an electronic version of the completed materials shall be provided on CD or DVD. Data can be in native file format or scanned where necessary.
2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
3. Submit BAS User’s Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
4. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
5. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Div. 1.

J Controls contractor shall provide Owner with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches. This service will be provided for 5 years as part of the contract price, and will be offered to Owner thereafter for the same price as to a dealer or branch.

K Manufacturers Certificates: For all listed and/or labeled products, provide certificate of
Product Warranty Certificates: Submit manufacturers product warranty certificates covering the hardware provided.

1.9 PROJECT RECORD DOCUMENTS

A Submit documents under provisions of Division 1.

B Record copies of product data and control shop drawings updated to reflect the final installed condition.

C Record copies of approved control logic programming and database on paper and on CD’s. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.

D Record copies of approved project specific graphic software on CDs.

E Provide as-built network architecture drawings showing all nodes including a description field with specific controller identification, description and location information.

F Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.

G Provide record riser diagram showing the location of all controllers.

H Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period.

1.10 SYSTEM ARCHITECTURE

A Integration:

1. BAS shall be excel 5000 protocol (or the latest approved upgrades by UNLV), with database and communication integrated into the Multi-System Integration Platform (MSIP), through the client’s WAN.

2. All aspects of BAS software and programming shall be complete at the client’s MSIP level, including sequences of operation, graphics, trending, and alarming, as defined specifically in Section 15955 & 15985, Section 15980, on the individual control drawings, and elsewhere in the contract documents.

3. Any proprietary BAS programming software required in addition to the MSIP programming software shall reside on all OWS, POT, and CSS associated with the project. These interface devices shall facilitate direct communication with and programming of the BAS associated with the project and also provide for web-based access to the MSIP via the client’s WAN.

B Application of Open Protocols: Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing Honeywell controls.

C The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.
D Intermittences or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

1. Secondary Controller LAN ('Secondary LAN'): Network used to connect AACs, and ASCs. These can be Master Slave/Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements and other requirements of the specifications.

E Individual Controllers: The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 15953.

1.11 WARRANTY MAINTENANCE

A Contractor shall warrant all new products and labor for a period of 2 years after Final Acceptance.

B The Owner reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS. Any disagreement between Owner and Contractor on such matters shall be subject to resolution through the contract ‘Disputes’ clause.

C At no cost to the Owner, during the warranty period, Contractor shall provide maintenance services for software, firmware and hardware components.

1. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer’s requirements.

2. In the last month of the warranty period, all System software and controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.

1.12 DELIVERY, STORAGE, AND HANDLING

A Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.13 LISTING AND LABELING

A The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A Materials shall be new, the best of their respective kinds without imperfections or blemishes, and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where drawings or specifications specifically allow existing materials to remain in place.
2.2 UNIFORMITY

A To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

A General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings, and details shown on drawings.

B Refer to additional requirements in other sections of this specification.

3.3 DIGITAL CONTROL STATIONS, CONTROLLER QUANTITY AND LOCATION

A Individual Digital Control Stations (DCS) are referenced to indicate allocation of points to each DCS and DCS location. Digital control stations shall consist of one or multiple controllers to meet requirements of this specification.

B Where a DCS is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Restrictions in applying controllers are specified in Section 15953 - BAS Field Panels. This Contractor shall extend power to the DCS from an acceptable power panel. If the control contractor wishes to further distribute panels to other locations, control contractor is responsible for extending power to that location also. Furthermore, contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.

C Contractor shall locate DCSs as referenced. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.

D Contractor shall provide a minimum of the following:
   1. One DCS (including at least one controller) in each chilled water/hot water plant mechanical room
   2. One DCS (including at least one controller) for each air handler located in applicable mechanical room or on roof
   3. One DCS (including at least one controller) for each critical fan system
   4. One DCS (including at least one controller) for each pumping system
   5. One controller for each piece of terminal equipment located at the equipment.

3.4 SURGE PROTECTION

A Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AACs, ASCs, operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage.
3.5 CONTROL POWER SOURCE AND SUPPLY

A BAS Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 15950 through 15980 and Sequences of Operation.

B General requirements for obtaining power include the following:
   1. In the case where additional power is required, obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 208V source, obtain power from the electrically most proximate 120v source fed from a common origin.
   2. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
   3. Standalone Functionality: Refer to Section 15953.

3.6 POWER MONITORING

A. Not applicable, as-is operation.

3.7 BAS OPERATOR TRAINING and O&M Manuals

A Provide up to 6 complete sets of the approved Operations and Maintenance (O&M) Manuals (hard copy and one electronic copy on CD in PDF format) to be used for training.

B Contractor shall submit a Training Plan for the scope of training for which (s)he is responsible. Training Plan shall be forwarded to the Division 15 Contractor who will compile, organize, format, and forward to the Engineer for review. Once approved by the Engineer, training times shall be coordinated with the CLIENT’S Project Manager for CLIENT’S acceptance of the times and class outline.

C Local Training: The local control contractor shall provide:
   1. One four (4) hour training courses for the designated CLIENT’S personnel to be performed at system demonstration.
   2. The class shall be taught by qualified personnel educated in the systems/products and adult learning techniques.
   3. Agenda: The course agenda shall include instruction on specific systems and instructions for operating the installed system. Topics covered shall include as a minimum:
      a. HVAC System Overview
      b. Operation of Control System
      c. Function of each Component
      d. System Operating Procedures
      e. Programming Procedures
      f. Maintenance Procedures

D Off-Site Advanced Training:
   1. Not applicable.

END OF SECTION
SECTION 15951
BAS MATERIALS, INTERFACE DEVICES, AND SENSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including Conformed General Conditions and
      Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this
      Section.
   B. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL
   C. Section 15959 - BAS COMMISSIONING
   D. Section 15952 - BAS OPERATOR INTERFACES
   E. Section 15954 - BAS COMMUNICATION DEVICES
   F. Section 15953 - BAS FIELD PANELS
   G. Section 15955 - BAS SOFTWARE AND PROGRAMMING
   H. Section 15980 - SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK
   A. Refer to Section 15950 for general requirements.
   B. Refer to other Division 15 sections for installation of instrument wells, valve bodies, and
      dampers in electro-mechanical systems; not work of this section.
   C. Provide the following electrical work as work of this section, complying with requirements of
      Division 16 sections:
      1. Control wiring between field-installed controls, indicating devices, and unit control
         panels.
      2. Interlock wiring between electrically interlocked devices, sensors, and between a hand
         or auto position of motor starters as indicated for all mechanical and controls.
      3. Wiring associated with enunciator and alarm panels (remote alarm panels) and
         connections to their associated field devices.
      4. All other necessary wiring for fully complete and functional control system as specified.

1.3 WORK BY OTHERS
   A. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet
      surfaces, shall be installed under the applicable piping Section under the direction of Section
      15951 Contractor who will be fully responsible for the proper installation and application.
   B. Power wiring for controlled equipment shall be furnished and installed under Division 16.
      Where 120 volt (V) control devices are used to control the equipment, Division 16 Contractor
      shall extend 120 V power wiring to the equipment. Section 15951 Contractor shall extend 120
      V power wiring from the equipment to the control devices.
PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General: Provide electronic and electric control products in sizes and capacities indicated, consisting of controllers, sensors, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer’s standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.

B. Instrument Pipe and Tube
1. Hydronic and Instruments
   a. Connection to Main Piping: Provide ½ inch minimum size threadolet, ½” x 2 inch brass nipple, and ½” ball valve for connection to welded steel piping. Provide tee fitting for other types of piping.
   b. Remote Instruments: Adapt from ball valve to specified tubing and extend to remote instruments. Provide a union or otherwise removable fitting at ball valve so that connection to main can be cleaned with straight rod. Where manifolds with test ports are not provided for instrument, provide tees with ¼” FPT branch with plug for use as test port. Adapt from tubing size to instrument connection.
   c. Line Mounted Instruments: Extend rigid piping from ball valve to instrument. Do not use close or running thread nipples. Adapt from ball valve outlet to instrument connection size. Provide a plugged tee if pipe makes 90 degree bend at outlet of valve to allow cleaning of connection to main with straight rod without removing instrument.
   d. Instrument Tubing: Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of ¼” or the instrument connection size.
   e. Rigid Piping For Line Mounted Instruments: Schedule 40 threaded brass, with threaded brass fittings.

2. Low Pressure Air Instrument Sensing Lines
   a. Connections: Use suitable bulkhead type fitting and static sensing tip for static pressure connections. Adapt tubing to instrument connection.
   b. Indoor Tubing: Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.
   c. Outdoor Tubing: Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of ¼” or the instrument connection size. Outdoor tubing shall be painted silver.

C. Communication Wiring: All wiring shall be in accordance with the latest edition of the National Electrical Code and Division 16.
   1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC’s, ASC’s and local and remote peripherals (e.g., operator workstations, printers, and modems).
   2. Local Supervisory LAN: For any portions of this network required under this section of the specification, Contractor shall use multimode fiber (62.5 micron) or Category 6E cable per TIA/EIA 68 (100BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturer’s recommendations for distances installed, with overall PVC cover, Class 2 run with no splices and separate from any wiring over thirty (30) volts. Refer to Division 26 for separation requirements. Shield shall be terminated and wiring shall be grounded as recommended by building controller manufacturer.

D. Signal Wiring: Contractor shall run all signal wiring in accordance with the latest edition of the National Electrical Code and Division 16.
   1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire (22-gauge acceptable for smart space sensors), with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
   2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.

E. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with the latest edition of the National Electrical Code and Division 16.
   1. Low voltage control wiring shall be minimum 18-gauge, twisted pair, 100% shielded, with PVC cover, Class 2. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.

F. Control Panels: Provide control panels with suitable brackets for wall mounting, unless noted otherwise, for each control system. Locate panel adjacent to systems served. Mount center of control panels 60” above finished floor in mechanical rooms or roof, or adjacent to unitary equipment installed outside mechanical rooms.
   1. General: All Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a UL-rated, NEMA enclosure suitable for the installed conditions.
   2. Panels Inside the Building Envelope: Panels shall be constructed of 16-gage steel, totally enclosed on four sides, with removable perforated backplane, hinged door and coin latch, with manufacturer’s standard shop-painted finish and color.
   3. Panels Outside the Building Envelope: Panels shall be constructed of 16-gage steel and have hinged door and lock hasp (owner will provide padlock). Provide hinged dead-front inside panel when flush-mounted control and/or indicating devices are included in panel. Panel interior shall be coupled to the cold deck of the RTU via a 2” conduit connection, the interior shall be internally lined with ½” rigid foam insulation, and a rainproof exhaust vent shall be provided.
   4. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip.
   5. All gauges and control components shall be identified by means of nameplates.
   6. All control tubing and wiring shall be run neatly and orderly fashion, providing 50% additional capacity, in open slot wiring duct with cover.
   7. Complete wiring and tubing termination drawings shall be mounted in, and a second set mounted adjacent to, each panel in a frame with lexan cover of sufficient size to be easily readable.

2.2 CONTROL VALVES

A. General: Provide factory fabricated control valves of type, body material and pressure class indicated. All valves shall have valve position indication on the valve. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating for any two-way valve/actuator combination shall be 110% of the total system (pump) head for water applications or 50 psig, whichever is greater.
B. **Globe Valves:**
1. **Valve Sizing:** Where not specifically indicated in the contract documents, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
2. **Single Seated (Two-way) Valves:** Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
3. **Double Seated (Three-way) Valves:** Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on ‘top-and-bottom’ guided plugs.
4. **Temperature Rating:** 25°F minimum, 250°F maximum.
5. **Body:** Bronze, screwed, 250 psi maximum working pressure for 1/2” to 2”; Cast iron, flanged, 125 psi maximum working pressure for 2-1/2” and larger.
6. **Valve Trim:** Bronze; Stem: Polished stainless steel.
7. **Packing:** Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
8. **Plug:** Brass, bronze or stainless steel, Seat: Brass.
9. **Disc:** Replaceable composition or stainless steel filled PTFE.
10. **Acceptable Manufacturers:** Subject to compliance with requirements, approved manufacturers are as follows:
   a. Belimo
   b. Honeywell

C. **Butterfly Valves:**
1. **Body:** Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
2. **Seat:** EPDM, except in loop bypass applications where seat shall be metal to metal.
3. **Disc:** Bronze or stainless steel, pinned or mechanically locked to shaft.
4. **Bearings:** Bronze or stainless steel.
5. **Shaft:** 416 stainless steel.
6. **Cold Service Pressure:** 175 psi.
7. **Close Off:** Bubble-tight shutoff to 150 psi.
8. **Operation:** Valve and actuator operation shall be smooth both seating and unseating. Should more than 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the Owner.
9. **Acceptable Manufacturers:** Subject to compliance with requirements, approved manufacturers are as follows:
   a. Belimo
   b. Honeywell

D. **Ball Valves:**
1. **Body:**
   a. **2” or less:** Valves shall utilize bronze bodies with female NPT threads. Valve bodies may also be stainless steel, titanium or nickel.
   b. **2-1/2” or greater:** Valves shall have flanged carbon steel or stainless steel bodies rated at 300 psi working pressure.
2. **Seat:** Reinforced Teflon.
3. **Ball:** Stainless steel.
4. **Port:** Segmented design with equal-percentage characteristic.
5. **Cavitation Trim:** Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
6. **Stem:** Stainless steel, blow-out proof design, extended to match thickness of insulation.
7. Cold Service Pressure: 200 psi WOG.
8. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
   a. Belimo
   b. Honeywell

2.3 ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.

B. Actuators
   1. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C).
   2. Two Position Electric Actuators: Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.
      a. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
         1) Belimo
         2) Honeywell
   3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-20VDC, 0-10VDC, or 4-20mA, as required. All modulating applications for primary HVAC equipment shall utilize true analog actuators. Simulated analog such as 3-point or pulse width modulation shall only be acceptable for VAV box terminal unit control.
      a. Actuators shall travel full stroke in less than 90 seconds (VAV terminal box actuators may be up to 300 second full stroke time).
      b. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.
      c. Actuators shall have positive positioning circuit, stroke indicator, current limiting motor protection, and manual position override.
      d. Modulating actuators for valves shall have minimum rangeability of 40 to 1.
      e. All actuator torque ratings shall be 150% of the requirements of the application. The minimum rating shall be 70 in-lbs for all actuators other than VAV box actuators. Provide a minimum of one actuator for each 25 square feet of damper area. For Multizone unit zones, provide 140 in-lbs for applications with four (4) or greater blades where one blade includes both hot and cold deck dampers.
      f. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning sized for required close-off pressure. Required close-off rating for any two-way valve/actuator combination shall be 110% of the total system (pump) head for water applications or 50 psig, whichever is greater. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.
      g. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
         1) Siemens
         2) Belimo
         3) Honeywell

C. Quarter-Turn Actuators (for ball valves):
   1. Electric
      a. Motor: Suitable for 120 or 240 volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.
      b. Gear Train: Motor output shall be directed to a self-locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor
torque.
c. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure
d. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
e. Enclosure: Actuator enclosure shall be a NEMA 4 epoxy coated metal enclosure, and shall have a minimum of two threaded conduit entries.
f. Limit Switches: Travel limit switches shall be UL approved. Switches shall limit actuator in both open and closed positions.
g. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
h. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.
i. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
j. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
k. Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.
l. Ambient Conditions: Actuator shall be designed for operation from –140 to 150 °F ambient with 0 to 100 percent relative humidity.

2.4 GENERAL FIELD DEVICES

A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.

B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.

C. Field devices specified herein are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with ‘two-wire’ type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide ‘four-wire’ type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.

E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.5 TEMPERATURE SENSORS (TS)

A. Sensor range: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.5°F (unless noted otherwise).
B. Room Temperature Sensor: install in return/exhaust ductwork (general exhaust).

C. Liquid Immersion Temperature Sensor: Shall consist of sensing element and connection head for wiring connections.
   1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.5°F accuracy at calibration point.
   2. Provide each sensor with brass or stainless steel thermowell of the appropriate length. Provide heat conductive compound between the well and sensor element.

2.6 HUMIDITY TRANSMITTERS
A. Room humidity Sensor: install in return/exhaust ductwork (general exhaust).

2.7 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)
A. Not applicable.

2.8 VALVE BYPASS FOR DIFFERENTIAL PRESSURE SENSORS
A. Not applicable.

2.9 OUTDOOR AIR STATIC PRESSURE SENSING TIP
A. Not applicable.

2.10 AIRFLOW MEASURING STATIONS (AFMS)
A. Not applicable.

2.11 DIFFERENTIAL PRESSURE SWITCHES (DPS)
A. Not applicable.

2.12 PRESSURE SWITCHES (PS)
A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.

B. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls.

2.13 CURRENT SWITCHES (CS)
A. Clamp-On Design Current Operated Switch (for Constant Speed Motor Status Indication)
   1. Range: 1.5 to 150 amps.
   2. Trip Point: Adjustable.
   3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
   4. Lower Frequency Limit: 6 Hz.
   5. Trip Indication: LED
   6. Approvals: UL, CSA
   7. Max. Cable Size: 350 MCM
B. Clamp-on Current Switch/Command Relay (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; or RE Technologies RCS 1150.
   1. Where used for single-phase devices, provide the CS/CR in a self-contained housing with override switch similar to Kele RIBX.

C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
   1. Range: 1.5 to 135 Amps.
   2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
   3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
   4. Frequency Range: 5-75 Hz
   5. Trip Indication: LED
   6. Approvals: UL, CSA
   7. Max. Cable Size: 350 MCM

D. Clamp-On Current Switch/Command Relay (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934. Substitutions shall be allowed per Division 1.

E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.14 CURRENT TRANSFORMERS (CT)

A. Clamp-On Design Current Transformer (for Motor Current Sensing)
   1. Range: 1-10 amps minimum, 20-200 amps maximum.
   2. Trip Point: Adjustable.
   3. Output: 0-5 VDC.
   4. Accuracy: ±0.2% from 20 to 100 Hz.
   5. Acceptable Manufacturers: KELE SA100.

2.15 POWER METER

A. Not applicable.

2.16 CONTINUOUS LEVEL TRANSMITTERS

A. Capacitance Type
   1. General: Provide a loop powered, continuous capacitance type level transmitter with adjustable span and zero.
   2. Output: 4-20 mA.
   3. Probe: Fluoropolymer coated stainless steel rod or cable. Provide cable probe with end attachment hardware or weight.
   5. Approvals: UL or CSA.
   6. Accuracy: ±1% of calibrated span.
7. Process Connection: MPT or ANSI Flange as required.

B. HYDROSTATIC PRESSURE
1. General: Two wire smart d/p cell type transmitter.
2. Output: 4-20 mA or 1 to 5 volt user selectable linear or square root output.
4. Probe: Stainless steel wetted parts.
5. Environmental Limits: −40 to 250 °F (−40 to 121°C), 0 to 100% RH.
6. Accuracy: Less than 0.1 percent of span.
7. Output Damping: Time constant user selectable from 0 to 36 seconds.
8. Vibration Effect: Less than ±0.1% of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
10. Approvals: FM, CSA.

2.17 INSERTION TYPE TURBINE METER FOR WATER SERVICE

A. Not applicable.

2.18 ELECTRIC CONTROL COMPONENTS

A. Manual Control Switches:
1. Shall be UL listed for use in NEMA 1 enclosures with contact arrangement and rating suitable for the application.
2. Shall be bat handle or knob actuator with nameplate clearly identifying function of each switch position.

B. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley, or equal.

C. Low Temperature Detector ('Freezestat') (FZ):
1. Shall be DPDT (4-wire, 2-circuit) with automatic reset.
2. Shall consist of a ‘cold spot’ element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8” x 20’ (3.2mm x 6.1m).
3. Temperature range 15 to 55°F (-9.4 to 12.8°C), factory set at 38°F.
4. Provide junction box for wiring connections and gasket to prevent air leakage or vibration.

D. Thermostats:
1. Not applicable.

E. Aquastats: Shall be UL listed bi-metal insertion type, manual reset, with contact arrangement and rating as required by application and separable well for water service. Provide with set point limit stops as follows:
1. Not applicable.

F. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA 1 enclosure for indoor locations, NEMA 4 for outdoor locations.
1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
   a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
   b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
   c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
d. Pilot light indication of power-to-coil and coil retainer clips.
e. Coil rated for 50 and 60 Hz service.
f. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA or approved equal.

2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC or approved equal.

3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.

4. All safety circuits shall be installed to operate individual interposing relays located in the associated equipment control panel. Each safety device (i.e. Freezestat, DP safety, smoke detector, etc.) wiring circuit shall be installed with individual homeruns back to the associated control panel.

G. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall have replaceable fuses in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 enclosure.
   1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson.

H. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley or approved equal.

I. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley or approved equal.

J. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory or approved equal.

K. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley or approved equal.

2.19 REFRIGERANT MONITOR

A. Not Applicable.

2.20 IDENTIFICATION

A. All control equipment shall be clearly identified by control shop drawing designation as follows:
   1. Other remote control devices - metal tags or laser printed, adhesive backed, metalized polyester film labels.
   2. Control Panels - engraved nameplate with panel number and system served
   3. Control Conduit Junction Boxes - Painted medium blue with orange stripe.
   4. Number-code or color-code electrical conductors and pneumatic tubing, excluding those used for individual zone controls. Reflect this tagging or color-coding system on the Project Record Documents
   5. Controller Identification. All controllers shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure with screws or rivets
6. Panel Identification. All local control panels shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure with screws or rivets.

7. Field Devices. All field devices shall be identified by a plastic engraved nameplate attached with screws or rivets.

8. Panel Devices. All panel devices shall be identified by a typed label securely fastened to the back plane of the local control panel.

2.21 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner.

3.2 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of the latest edition of the National Electrical Code and all local codes.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.

1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Installation of wiring shall generally follow building lines. Install in accordance with the latest edition of the National Electrical Code and Division 16. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with the latest edition of the National Electrical Code and Division 16.

3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.

4. All WAN and LAN communication wiring shield shall be terminated as recommended by controller manufacturer. All WAN and LAN communication wiring shall be labeled with a network number, device ID at each termination and shall correspond with the WAN and LAN system architecture and floor plan submittals.

5. Install all control wiring external to panels in conduit. Installation of wiring shall generally follow building lines. Provide compression type connectors. Install wiring in galvanized rigid steel conduit at all exterior locations and where subjected to moisture or vandalism. Install in PVC Schedule 40 conduit if encased in concrete and below ground locations. All conduits penetrating partitions, walls or floors shall be sealed with...
a submitted and approved non-hardening putty material to prevent migration of air through the conduit system. There shall be no conduit run on the roof; all conduit run to rooftop equipment shall penetrate the plane of the roof inside the equipment curb.

6. All control conduits shall be identified by color code. Conduit shall be painted orange and blue at least every 10 feet, at all junctions, and at all wall penetrations.

7. Communication cabling shall be provided in an Owner approved color dedicated to the BAS.

8. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.

C. Outside Air Temperature/Humidity Sensors: An aspirated weatherproof and vandal proof enclosure shall be provided for outside air temperature and humidity sensors. These shall be mounted high on a north-facing exposure, clear from any undesirable influence (air intake, exhaust, heat source, etc.).

D. Averaging Temperature Sensors: Cover no more than three square feet per linear foot of sensor. The sensor shall be installed according to manufacturer's recommendation and looped and fastened at a minimum of every 36 inches.

E. Low Temperature Detector ('Freezestat') (FZ): Cover no more than one square foot per linear foot of sensor. The sensor shall be installed according to manufacturer's recommendation and looped and fastened at a minimum of every 36 inches.

F. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.

G. Relative Humidity Sensors:
   1. Provide element guard as recommended by manufacturer for duct probes in high velocity installations.
   2. Duct mounted sensors shall be mounted a minimum of 20 duct diameters downstream of any type of humidifiers or evaporative cooling equipment.
   3. Provide lockable metal guards for all sensors located in public areas.

H. Water Differential Pressure Transmitters: Provide valve bypass arrangement to protect against over pressure damaging the transmitter.

I. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications. Install per manufacturers recommendations.

J. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below minimum operating current and above motor no load current.

END OF SECTION
SECTION 15952
BAS OPERATOR INTERFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.

B. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

C. Section 15959 - BAS COMMISSIONING

D. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

E. Section 15954 - BAS COMMUNICATION DEVICES

F. Section 15953 - BAS FIELD PANELS

G. Section 15955 - BAS SOFTWARE AND PROGRAMMING

H. Section 15980 - SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK

A. Furnish and install all Operator Interfaces as required for the BAS functions specified.

B. Refer to Section 15950 for general requirements.

PART 2 - PRODUCTS

2.1 MSIP WEB SUPERVISOR

A. A single Web Supervisor is used by UNLV to access its schools through one common interface (including programming) and as a single point for Master scheduling, trending, and alarming.

B. The Web Supervisor is existing.

C. The UNLV Environmental System Department MSIP Web Supervisor is existing and shall be reconfigured as necessary to facilitate integration of this project.

PART 3 - EXECUTION – NOT USED

END OF SECTION
SECTION 15953
BAS FIELD PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.

B. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

C. Section 15959 - BAS COMMISSIONING

D. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

E. Section 15952 - BAS OPERATOR INTERFACES

F. Section 15954 - BAS COMMUNICATION DEVICES

G. Section 15955 - BAS SOFTWARE AND PROGRAMMING

H. Section 15980 - SEQUENCES OF OPERATION

1.2 PROCUREMENT

A. All new BAS, DDC, and communications components installed as work of this contract, shall be an integrated distributed processing system by Honeywell Controls.

1.3 DESCRIPTION OF WORK:

A. Furnish and install new DDC Control units required to support specified BAS functions.

B. Refer to Section 15950 for general requirements.

PART 2 - PRODUCTS

2.1 STAND-ALONE FUNCTIONALITY

A. General: These requirements define stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.

B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Systems specified for the Application Category will dictate the boundary of the standalone control functionality (see related restrictions below). When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.
C. The following configurations are considered acceptable with reference to a controller’s standalone functionality:

1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices. All wiring to interconnect the I/O expander board shall be:
   a. Contained in the control panel enclosure;
   b. Or run in conduit. Wiring shall only be accessible at the terminations.

2.2 BUILDING CONTROLLER (BC)

A. General Requirements:

1. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
2. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACS/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from an operator workstation, portable operator terminal, or hand held operating device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
3. BCs shall be connected to a controller network that qualifies as a Primary Controlling LAN.
4. All BCs shall be protected from any memory loss due to a loss of power by one or a combination of the following:
   a. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of fifty (50) hours, and a rated shelf life of at least five years. Self-diagnostics routine shall report an alarm for a low battery condition.
   b. EEPROM, EPROM, or NOVROM non-volatile memory
5. In addition BCs shall provide intelligent, standalone control of HVAC functions. Each BC shall be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
6. The BC shall provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to standalone functionality specified above.
7. All BC point data, algorithms and application software shall be modifiable from the Operator Workstation.
8. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each
BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS.

9. BC shall provide buffer for holding alarms, messages, trends etc.

10. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.

11. Each BC shall contain software to perform full DDC/PID control loops.

12. For systems requiring end-of-line resistors those resistors shall be located in the BC.

13. BC Input-Output Processing:
   a. Multiplexing of IO Points Unacceptable: Each input and output shall be a discrete input or output on the BC controller board. The use of supplementary input or output multiplexing boards, or any configuration that combines multiple inputs or outputs into a single point on the controller, is not acceptable.
   b. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Provide feedback to remotely indicate the HOA is not in the Auto position. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure. Provide suppression to limit transients to acceptable levels.
   c. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. A/D converters shall have a minimum resolution of 10 bits.
   d. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board.
   e. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
   f. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection.
   g. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

14. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or workstations.

15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.

16. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.

17. Slope intercepts and gain adjustments shall be available on a per-point basis.

18. BC Power Loss:
   a. Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
   b. Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
   c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent
function is possible without manual reset of the clock. All monitored functions shall be updated.

d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the operator workstation via the local area network, or via the telephone line dial-up modem where applicable, or to the laptop PC via the local RS-232C port.

19. BC Failure:
   a. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and reconfigure the LAN.
   
   b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

20. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).

21. BCs may include LAN communications interface functions for controlling secondary controlling LANs Refer to Section 15954 - BAS Communication Devices for requirements if this function is packaged with the BC.

22. A minimum of four levels of password protection shall be provided at each BC.

23. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.

24. In the last month of the warranty period, all controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.

B. BACnet Building Controller Requirements:
   1. The BC(s) shall support all BIBBs defined in the BACnet Building Controller (B-BC) device profile as defined in the BACnet standard.
   2. BCs shall communicate over the BACnet Building Controller LAN.
   3. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.

C. ADVANCED APPLICATION SPECIFIC CONTROLLER (AAC) AND APPLICATION SPECIFIC CONTROLLER (ASC)

D. General Requirements:
   1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.
   2. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
   3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
   4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 8 bit A to D conversion,
voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty- (50) hrs with a battery life of five years.

5. All point data, algorithms and application software within an AAC /ASC shall be modifiable from the Operator Workstation.

6. In the last month of the warranty period, all controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.

7. AAC and ASC Input-Output Processing
   a. Multiplexing of IO Points Unacceptable: Each input and output shall be a discrete input or output put on the AAC/ASC board. The use of supplementary input or output multiplexing boards, or any configuration that combines multiple inputs or outputs into a single point on the controller, is not acceptable.
   b. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Provide feedback to remotely indicate the HOA is not in the Auto position. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure. Provide suppression to limit transients to acceptable levels.
   c. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. A/D converters shall have a minimum resolution of 10 bits.
   d. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the AAC/ASC and shall be isolated from the main board.
   e. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
   f. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection.
   g. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.

E. BACnet AAC(s) and ASC(s) Requirements:
   a. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.
   b. AAC(s) and ASC(s) shall communicate over the BACnet Building Controller LAN or the ASC LAN or sub-LAN.
   c. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer’s instructions, specifications roughing-in drawings and details shown on drawings. Contractor shall install all controllers in accordance with manufacturer’s installation procedures and practices.

B. Mounting: All controllers shall be mounted within control panels as defined in Section 15951.
3.3 HARDWARE APPLICATION REQUIREMENTS

A. General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A BC as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.

B. Standalone Capability: Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Item 2.01 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs via LAN.

C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.

D. Application Category 0
1. Applications in this category include the following:
   a. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
2. Points on BCs, AACs, and ASCs may be used in these applications as well as general-purpose I/O modules.
3. Where these points are trended, contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.

E. Application Category 1
1. Applications in this category include the following:
   a. Airflow Control Boxes (Constant Volume Terminal Units)
   b. Misc. Heaters
   c. Unitary equipment <15 tons (Package Terminal AC Units, Split-System AC Units, water source heat pumps).
2. ASCs may be used in these applications.
3. Standalone Capability: Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

| Physical/Virtual Point       | Default Value
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduling Period</td>
<td>Occupied</td>
</tr>
<tr>
<td>Morning Warm-Up</td>
<td>Off (cold discharge air)</td>
</tr>
<tr>
<td>Summer/Winter</td>
<td>Winter</td>
</tr>
<tr>
<td>Trend Data</td>
<td>N/A</td>
</tr>
</tbody>
</table>

4. LAN Restrictions: For networks operating at 38.4 kbps or less, limit the number of
nodes on the network to meet all system performance criteria and to no more than 80% of the maximum recommended by the manufacturer. For networks operating at greater than 38.4 kbps limit the number of nodes on the network to meet all system performance criteria up to the maximum recommended by the manufacturer.

F. Application Category 2
1. Applications in this category include the following:
   a. Unitary Equipment >= 15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and the like)
   b. Small, Constant Volume Single Zone Air Handling Units
   c. Constant Volume Pump Start/Stop
   d. Misc. Equipment (Exhaust Fan) Start/Stop
   e. Misc. Monitoring (not directly associated with a control sequence and where trending is not critical)
2. BCs may be used in these applications.
3. ASC’s may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
4. Standalone Capability: Only the following data (as applicable) may be acquired from other AACs/ASCs via LANs. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

<table>
<thead>
<tr>
<th>Physical/Virtual Point</th>
<th>Default Delay Time</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Air Temperature</td>
<td>5 minutes</td>
<td>80°F</td>
</tr>
<tr>
<td>Outside Air Humidity</td>
<td>5 minutes</td>
<td>60%RH</td>
</tr>
<tr>
<td>Outside Air Enthalpy</td>
<td>5 minutes</td>
<td>30 Btu/lb</td>
</tr>
<tr>
<td>Trend Data</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Cooling/Heating Requests</td>
<td>5 minutes</td>
<td>None</td>
</tr>
</tbody>
</table>

5. LAN Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 32.

G. Application Category 3
1. Applications in this category include the following, but does not apply to this project (N.I.C.):
   a. Large Constant Volume Air Handlers
   b. Air Handlers serving critical areas
   c. Central Heating Plant
   d. Sequenced or Variable Speed Pump Control
2. BCs shall be used in these applications.
3. LAN Restrictions: Comply with 2.01, Stand-Alone Functionality, above.

3.4 CONTROL UNIT REQUIREMENTS

A. Refer to Section 15950 for requirements pertaining to control unit quantity and location.

END OF SECTION
SECTION 15954
BAS COMMUNICATION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:
A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.
B. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL
C. Section 15959 - BAS COMMISSIONING
D. Section 15951 - BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
E. Section 15952 - BAS OPERATOR INTERFACES
F. Section 15953 - BAS FIELD PANELS
G. Section 15955 - BAS SOFTWARE AND PROGRAMMING
H. Section 15980 - SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK
A. BAS Contractor shall provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways to the Owner’s Wide Area Network (CLIENT’S WAN).
B. The intent of all specified interface to packaged controls is that the interface be provided by this section, even if specific terminations for remote inputs or outputs are not provided by the packaged equipment controls. This shall be provided by adding interposing relays, paralleling analog signals or biasing setpoints. The specific means of interface shall be coordinated between the BAS contractor and the packaged equipment vendor. If specific terminations for remote monitoring or control are provided, these shall be utilized.
C. It is not the intent for this section to provide major components for the packaged controls that do not exist (other than the interface methods listed above). However, the BAS hardware, software, conduit and wire shall be installed for future connection to the interface. For example, if setpoint reset card for a chiller has not been provided with the chiller package, it is not the intent for this section to provide such card.

PART 2 - PRODUCTS

2.1 NETWORK CONNECTION
A. It is assumed that this connection exists. Honeywell shall verify its compliance.

2.2 MULTIPLE SYSTEM INTEGRATION PLATFORM INTERFACE DEVICE (MSIPID)
A. It is assumed that MSIPID exists. Honeywell shall verify its compliance.
2.3 LOCAL SUPERVISORY LAN INTERFACE DEVICE (LANID)

A. It is assumed that LANID exists. Honeywell shall verify its compliance.

2.4 VFD Interface Device (VFDID)

A. The VFDID shall be a microprocessor-based communications device that acts as a gateway between the BAS protocol and the applicable VFD controller.

B. The VFDID shall contain its own microprocessor, RAM, battery, communication ports and, power supply.

C. Each VFDID shall support full bi-directional communication.

D. Communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, acceleration/deceleration time adjustments, and lock and unlock the keypad. The drive shall allow the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus; keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over the communications interface. A minimum of 15 field parameters shall be capable of being monitored.

E. The VFD shall allow the BAS to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the BAS system.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer’s instructions, roughing-in drawings and details shown on drawings.

B. Contractor shall provide all interface devices and software to provide an integrated system.

END OF SECTION
SECTION 15955
BAS SOFTWARE AND PROGRAMMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.

B. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

C. Section 15959 - BAS COMMISSIONING

D. Section 15951 - BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

E. Section 15952 - BAS OPERATOR INTERFACES

F. Section 15953 - BAS FIELD PANELS

G. Section 15954 - BAS COMMUNICATION DEVICES

H. Section 15980 - SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK:

A. Control software, its licensing and devices are existing and shall be reused and utilized to perform complete sequence as stated in these documents.

PART 2 - PRODUCTS

2.1 SYSTEM SOFTWARE-GENERAL

A. Functionality and Completeness: Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.

B. Configuration: The software shall support the system as a distributed processing network configuration.

2.2 CONTROLLER SOFTWARE

A. BC Software Residency: Each BC as defined below shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:
   1. Real-Time Operating System software
   2. Real-Time Clock/Calendar and network time synchronization
   3. BC diagnostic software
   4. LAN Communication software/firmware
   5. Direct Digital Control software
6. Alarm Processing and Buffering software
7. Energy Management software
8. Data Trending, Reporting, and Buffering software
9. I/O (physical and virtual) database
10. Remote Communication software

B. AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Section 15954) with the restrictions/exceptions per application provided in Section 15953:
   1. Real-Time Operating System software
   2. AAC/ASC diagnostic software
   3. LAN Communication software
   4. Control software applicable to the unit it serves that will support a single mode of operation
   5. I/O (physical and virtual) database to support one mode of operation

C. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Section 15953 for other aspects of stand-alone functionality.

D. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Section 15953 for other aspects of the controllers operating system.

E. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN.

F. Point Database/Summary Table: All points included in the typical equipment point list must be represented to Owner’s WAN in a common, open protocol format. Naming conventions for these points and network addressing are discussed in Part III of this section. Point/system database creation and modification shall be via a user-friendly, menu-driven program. System software shall support virtual or logic point (points not representing a physical I/O) creation. Software shall support virtual points with all services specified herein. Database software shall support definition of all parameters specified in Part III of this section for a given point type. If database does not support all of these parameters software module shall be created and attached to the points which accomplish the respective function.

G. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions.

H. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.

I. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
   1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
   2. Two Position control (Hi or Low crossing with deadband)
   3. Single-Pole Double-Throw relay
   4. Delay Timer (delay-on-make, delay-on-break, and interval)
   5. Hi/Low Selection
6. Reset or Scaling Module
7. Logical Operators (And, Or, Not, Xor)

PART 3 - EXECUTION

3.1 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, CSS, OWS, remote operator workstation, portable operators terminal, printer, and remote communications.

END OF SECTION
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SECTION 15959

BAS COMMISSIONING

PART 1 - GENERAL

1.1 RELATED SECTIONS:

A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.

B. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

C. Section 15951 - BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

D. Section 15952 - BAS OPERATOR INTERFACES

E. Section 15953 - BAS FIELD PANELS

F. Section 15954 - BAS COMMUNICATION DEVICES

G. Section 15980 - SEQUENCES OF OPERATION

1.2 GENERAL DESCRIPTION

A. This section defines responsibilities of the Controls Contractor to commission the BAS. This commissioning applies to new equipment that is installed as part of this HVAC and control upgrade project.

1.3 CONTRACTOR RESPONSIBILITIES

A. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.

B. Compensation for Retesting: Contractor shall compensate Owner for site time necessitated by incompleteness of systems or equipment at time of point to point functional and system performance testing. All critical testing failures as determined by CLIENT’S project manager and Energy Management Dept., which require on-site time for retesting, will be considered actual damages to the Owner. All parties under contract with the Owner who are affected by the retesting shall be included in the contract modification. Functional testing will commence 30 days prior to substantial completion.

1.4 SEQUENCING

A. The following list outlines the general sequence of events for submittals and commissioning:

1. Submit product data and shop drawings, and receive approval.
2. Submit BAS logic documentation, and receive approval.
3. Submit background graphic screens, and receive approval.
4. Submit Start-Up Checklists and manufacturer’s start-up procedures for all equipment provided by the BAS Contractor.
5. Install BAS.
6. Submit BAS Start-Up Test Agenda and Schedule for review.
7. Receive BAS Startup Test Agenda/schedule approval.
9. Simulate sequencing and debug program off-line to the extent practical.
10. Place systems under BAS control where applicable during a scheduled outage.
11. Perform BAS Startup where applicable during a scheduled outage.
12. Prepare and initiate trend log data storage and format trend graphs.
13. Submit completed BAS Start-Up Reports and initial draft of the O&M Manuals.
15. Receive demonstration approval and approval to schedule Acceptance Period.
16. Substantial Completion
17. Begin Acceptance Phase.
18. Two-week Operational Test.
20. Receive Acceptance Period approval, which is Functional Completion for the BAS.
21. Provide Level 1 (Admin Level) password access to the Owner.
22. Revise and re-submit as-built record drawings and O&M Manuals.
23. Final Acceptance.
24. Begin Warranty Phase.
25. Schedule and begin Opposite Season acceptance period.
26. Receive Opposite Season acceptance period approval.
27. Submit as-built record drawings and O&M Manuals.
28. Install framed control drawings.
29. End-of-Warranty date/period.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. Instrumentation required to verify readings and test the system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Generally, no testing equipment will be required beyond that required to perform Contractors work under these Contract Documents. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding year. Certificates of calibration shall be submitted.

PART 3 - EXECUTION

3.1 BAS START-UP TESTING, ADJUSTING, CALIBRATION

A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
1. Inspect the installation of all devices. Review the manufacturer’s installation instructions and validate that the device is installed in accordance with them.
2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
3. Verify integrity/safety of all electrical connections.
4. Contractor shall provide assistance to the TAB contractor to facilitate testing, adjusting, and balancing of the system. Coordinate with TAB subcontractor to obtain, program, and record control settings that are determined from balancing procedures.
5. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS Startup Report.
6. Check and set zero and span adjustments for all transducers and transmitters.
7. Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the Operator Interface display. Record the results for each device in the BAS Start-Up Report.

8. For outputs to reset other manufacturer’s devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.

9. Verify proper sequences by using the approved checklists to record results and submit with BAS Start-Up Report. Verify proper sequence and operation of all specified functions.

10. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.

11. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Startup Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows:
   a. Hot water temperature: ±2°F.
   b. Water pressure: ±1 psid

12. For interface and DDC control panels:
   a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the as-built record drawings.
   b. Ensure that terminations are safe, secure and labeled in accordance with the as-built record drawings.
   c. Check power supplies for proper voltage ranges and loading.
   d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
   e. Check for adequate signal strength on communication networks.
   f. Check for standalone performance of controllers by disconnecting the controller from the LAN and cycling controller power. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection and that controller retains its memory.
   g. Ensure that all outputs and devices fail to their proper positions/states.
   h. Ensure that buffered and/or volatile information is held through power outage.
   i. With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
   j. Check for adequate grounding of all DDC panels and devices.

13. For MSIP Interface:
   a. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
   b. Verify that the alarm reporting and logging is functional and per requirements.
   c. Verify that trends are configured and are archiving to disk as required.

14. Verify proper interface with fire alarm system.

B. Submit Start-Up Test Report: Report shall be completed, submitted, and approved prior to Substantial Completion.

3.2 SENSOR CHECKOUT AND CALIBRATION

A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other for pressure. Tolerances for critical applications may be tighter.

B. Calibration: Calibrate all sensors using one of the following procedures:
1. **Sensors without Transmitters - Standard Application:** Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.

2. **Sensors with Transmitters - Standard Application:** Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer’s resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

C. **Sensor Tolerance:** Sensors shall be within the tolerances specified for the device. Refer to Section 15951.

### 3.3 COIL VALVE LEAK CHECK

A. Verify proper close-off of the valves. Ensure the valve seats properly seat by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the Operator Interface, command the valve to close. Energize fans. After 5 minutes or longer, and the temperature is stable, observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

### 3.4 VALVE STROKE SETUP AND CHECK

A. For all valve and actuator positions checked, verify the actual position against the Operator Interface readout.

B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position doesn’t reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

### 3.5 BAS DEMONSTRATION

A. Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Owner prior to Substantial Completion. Schedule the demonstration with the Owner’s representative 2 weeks in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the Work fails to be demonstrated to conform to Contract specifications.

B. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems. All training documentation and submittals shall be at the job site.
C. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the Owner.

D. The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved Checklists. Demonstration shall include, but not necessarily be limited to, the following:
   1. Demonstrate that required software is installed on BAS Operator Interfaces.
   2. Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all Operator Interfaces and the MSIP, as specified.
   3. Where required, demonstrate that remote communication abilities are in accordance with these Specifications.
   4. Demonstrate correct calibration of input/output devices using the same methods specified for the Start-Up Tests. A maximum of 10 percent of I/O points shall be selected at random by the Owner for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
   5. Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
   6. Demonstrate that all DDC programs accomplish the specified sequences of operation.
   7. Demonstrate that the panels automatically recover from power failures, as specified.
   8. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
   9. Identify access to equipment and demonstrate that access is sufficient to perform required maintenance.

E. BAS Demonstration shall be completed and approved prior to Substantial Completion.

F. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be retested.

3.6 BAS ACCEPTANCE PERIOD

A. 30 days prior to substantial completion, BAS demonstration shall commence. The Acceptance Period shall not be scheduled until all HVAC systems are in operation and have been accepted; including all required cleaning and lubrication completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and TAB report has been submitted and approved. If the HVAC systems are not ready for testing at the beginning of the 30 days prior to substantial completion, the General Contractor will be responsible.

B. Operational Test: Prior to the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, contractor shall forward the trend logs to the Owner for review. Owner shall determine if the system is ready for functional performance testing and document any problems requiring contractor attention.

C. During the Acceptance Period, the contractor shall maintain a hard copy log of all alarms generated by the BAS. For each alarm received, Contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the Contractor’s opinion, the cause of the alarm is not the responsibility of the Contractor, Contractor shall immediately notify the Owner’s representative.
3.7 TREND LOGS
A. Contractor shall configure and analyze all trends required under Section 15955 & 15985.

3.8 TREND GRAPHS
A. Trend graphs as specified in Section 15955 & 15985 shall generally be used during the Acceptance Phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the Acceptance Period. Trend graphs shall demonstrate compliance with contract documents.
B. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

3.9 WARRANTY PHASE BAS OPPOSITE SEASON TRENDING AND TESTING
A. Trending: Throughout the Warranty Phase, trend logs shall be maintained as required for the Acceptance Period. Contractor shall forward archive trend logs to the Owner for review upon Owner request. Owner will review these and notify contractor of any warranty work required.
B. Opposite Season Testing: Within 12 months of completion of the Acceptance Phase, Owner shall schedule and conduct Opposite Season functional performance testing. Contractor shall participate in this testing and remedy any deficiencies identified.

END OF SECTION
SECTION 15980
SEQUENCES OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.

B. Section 15750 – HUMIDIFICATION SYSTEM

C. Section 15855 – ROOFTOP AIR HANDLING UNIT WITH COIL

D. Section 15930 – LAB PRESSURIZATION CONTROLS

E. Section 15945 – BUILDING COMMISSIONING

F. Section 15950 - BUILDING AUTOMATION SYSTEM (BAS) GENERAL

G. Section 15951 - BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

H. Section 15952 - BAS OPERATOR INTERFACES

I. Section 15953 - BAS FIELD PANELS

J. Section 15954 - BAS COMMUNICATION DEVICES

K. Section 15955 - BAS SOFTWARE AND PROGRAMMING

L. Section 15959 - BAS COMMISSIONING

M. Section 15985 – MULTIPLE SYSTEM INTEGRATION PLATFORM

1.2 SYSTEM DESCRIPTION

A. This Section defines the manner and method by which the controls operate and sequence the controlled equipment. Included in this section are general requirements and logic strategies that expand on the specific sequences shown on the drawings.

B. Refer to the drawings and sequences of operation. Drawing includes the following:

1. Design Intent: A brief outline of the purpose and the design engineer’s expectations for the system.

2. Detailed Sequence of Operation: References may be made to specific logic strategies defined in this section.

3. Points List: The points presented list defines the analog and digital inputs and outputs of the air valves and laboratory pressurization system to the BAS:
   a. The points list does not identify field interlocks and may show a single Point that controls multiple field devices. Any required interlocks are identified in the written sequence or the controls schematic.
   b. The number of field devices controlled shall be determined by the sizes of equipment scheduled on the mechanical drawings and the type of components selected by the BAS Contractor. An example is damper actuators, the points
lists will identify a single analog output point, the schematic may show one or two actuators, but the size of the unit and the actuators may dictate that multiple actuators are required.

PART 2 - PRODUCTS - Not used.

PART 3 - EXECUTION

3.1 GENERAL

A. Sequences specified herein and on the drawings indicate the standard and functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation.

B. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.

C. All setpoints and control parameters shall be adjustable both from any operator interface, without any required re-programming of software code.

D. All control loops shall utilize PID control algorithms unless otherwise specified in the sequence of operation. Throttling ranges, proportional bands, and cycle differentials shall be centered on the associated. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified “proportional only” or “P+I”, Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.

E. Safeties:
   1. All HVAC safeties shall be hardwired such that the shutdown will occur both in Automatic and Hand modes at the BAS system and the starter. Software safeties are not acceptable.
   2. Exception: All automatic reset type freeze protection thermostats shall have a separate DDC input and shall shutdown and lockout the system as specified. Provide a freeze alarm reset button on the BAS workstation graphic.

F. When air handling units are not in operation, control devices shall remain in their OFF positions. OFF positions may differ from the NORMAL (meaning failed) position. Except as specified otherwise, OFF and NORMAL positions of control devices shall be as follows:

<table>
<thead>
<tr>
<th>Device</th>
<th>OFF Position</th>
<th>NORMAL Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside air damper</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Exhaust air damper</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Return air damper</td>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>HW Valves</td>
<td>Closed</td>
<td>Closed</td>
</tr>
</tbody>
</table>

G. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5 second (adj.) intervals to minimize inrush current.

H. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated, one of the following methods shall be employed:
1. Contractor shall determine a fixed reset schedule which shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.

2. A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.

3. For whichever reset strategy is incorporated, provide a summary of reset operation on the associated system graphic. Information displayed shall include: controlled variable value, compensation variable value, reset ranges, etc.

I. Where a supply air temperature setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, the following method shall be employed:

1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. space temperature) setpoint. The reset increment shall be determined by the quantity of "need heat" or "need cool" requests from individual Terminal Controller. A Terminal Controller’s “need heat” virtual point shall activate whenever the zone’s space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A Terminal Controller’s “need cool” virtual point shall activate whenever the zone’s space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values shall limit the setpoint range.

J. Where a supply air temperature, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method shall be employed:

1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. The BAS analog output value shall be acceptable as indicating the position of the control device.

2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the “need heat” or “need cool” virtual point shall increment by one unit each time a zone’s valve/damper position rises to greater than 95%. The quantity of “need heat” or “need cool” points shall then be the basis for reset.

K. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS, after an adjustable time delay after the device is commanded to operate (feedback delay), confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm shall be enunciated audibly and via an alarm message at the operator interface and print at the alarm printers. A descriptive message shall be attached to the alarm message indicating the nature of the alarm and actions to be taken. Contractor shall provide messages to meet this intent.

L. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
1. Speed control of variable speed drives
2. Any temperature setpoint reset
3. Travel rate of tower isolation valves

M. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.

3.2 ROOFTOP AIR HANDLING/CONDITIONING UNITS – SCHEDULES AND OPERATING MODES

A. Laboratory year schedules: The following is a definition of applicable schedules:
   1. Normal Schedule:
      a. Building is in session
      b. Systems are allowed to enter occupied mode
   2. Holiday/Event/Break Schedule:
      a. Building is out of session
      b. Systems stay in unoccupied mode unless a Holiday/Event time is entered in which case the system will enter occupied mode

B. Operating Modes: The following operating modes are applicable to all air condition systems:
   1. Occupied Mode: The period of time when the building is in use and occupied
      a. The outside air damper shall open.
      b. All control loops and setpoints shall be released to automatic.
      c. All interlocked exhaust fans shall energize.
      d. Space temperature setpoints shall be in the “normal” range.
   2. Unoccupied Mode: The period of time when the building is not in use and is unoccupied.
      a. All compressors shall down unless a safety is energized.
      b. Heat section shall down unless a safety is energized.
      c. All fans shall de-energize.
      d. All control loops shall be reset to zero and locked out.
      e. Unoccupied Mode Override:
         1) During unoccupied mode, the associated air-handling unit shall be indexed to occupied mode if any zone temperature falls below 55°F or above 85°F. An alarm shall be generated at the workstation indicating an unoccupied override event.
         2) Upon sensing a minimum zone temperature greater than 68°F or the warmest zone temperature less than 78°F, the unit shall index back to unoccupied mode if scheduled by the time schedule.
   3. Warm-up Mode: Time prior to the Occupied Mode period when the system needs to add heat, in order to return the space temperatures from setback to “normal” or occupied setpoints. Minimum ventilation air shall be introduced.
      a. The outdoor dampers shall remain min. to outside air and the related exhaust fans shall run at min., face and by-pass damper shall fully close to by-pass.
      b. All other control loops shall be released to automatic, and heating coil shall be initiated to maintain space temperature at setpoint.
      c. Upon sensing a return air temperature greater than 70°F, or if the unit has been in Warm-up Mode for greater than 60 minutes:
         1) The outside air damper, and related exhaust fans shall be released to automatic operation.
         2) The unit shall be placed in Occupied Mode.
   4. Cool-down Mode: The time prior to the Occupied Mode period when the system needs to remove heat, in order to return the space temperatures from setback to “normal” or occupied setpoints.
      a. The outdoor dampers shall remain min. to outside air and the related exhaust
fans shall ne min. face and by-pass damper shall fully close to by-pass.

b. All other control loops and setpoints shall be released to automatic.
c. Upon sensing a return air temperature less than 78°F, or if the unit has been in Cool-down Mode for greater than 60 minutes:
   1) The outside air damper, and related exhaust fans shall be released to automatic operation.
   2) The unit shall be placed in Occupied Mode.

C. Unit Enable/Disable: AC unit shall be enabled and disabled through an occupied/unoccupied mode time schedule, as defined above:
   1. The unit shall be enabled one (1) hour prior to lab-in-session. When the air handler unit is enabled, the supply fan shall energize. After 60 seconds:
      a. If the return air is less than 60°F (adjustable), the unit shall be placed into Warm-up Mode.
      b. If the return air is greater than 78°F (adjustable) and the outside air is greater than 80°F, the unit shall be placed into Cool-down Mode.
      c. If not in Warm-up mode or Cool-down mode, the unit shall be placed into Occupied Mode.
   2. The unit shall be disabled one (1) hour after building is out of session, based on the occupied schedule. When the unit is disabled, the unit shall be placed into Unoccupied Mode.

3.3 AIR CONDITIONING UNITS – LOGIC STRATEGIES

A. General: The BAS shall supply, install all controls and fully control the air conditioning units per the Schedules and Operating modes defined above and the Sequences of Operation shown on the control drawings. The specific logic strategies defined here shall be included by reference, if required, from each air conditioning unit sequence of operation.

B. OA Control: BAS shall maintain required air flow (min-max.) during the occupied period.

C. VAV Exhaust Fan Capacity Control: BAS shall control the output of the exhaust fan as follows:
   1. Flow Tracking: The exhaust air fan shall run to maintain exhaust flow setpoint of the supply flow minus an offset value. The offset value shall be per schedules for air valves.

D. Outside Air Section, Face and By-pass Controls: BAS shall modulate the face and by-pass damper dampers shall be modulated in a DA PID loop, and at outside air section, to maintain mixed air temperature equal to supply air setpoint (55°F, adjustable) as specified for the AC unit. This logic shall remain enabled during Cool-down Mode where applicable.

E. Sequenced Heating and Cooling: BAS shall control the heating hot water coil or heating cycle by heat pump and cooling coil and face and by-pass function as detailed. Program logic shall directly prohibit the heating and cooling cycles to function simultaneously. As well as unnecessary heating or cooling function, when they could be avoided by proper by-passing of the outside air via by-pass section.

F. Freeze Safety: Upon operation of a freezestat, AC fans shall also be de-energized via a hardwired interlock. All freezestats shall be automatic reset type and shall have a separate DDC input that shall, via software, command the fans to stop, command the economizer dampers to their NORMAL positions, command the Heating section to start, and enunciate appropriate alarm. Provide a freeze alarm reset button on the BAS workstation graphic to allow operator reset of the safety shutdown.

G. Smoke Safety: Upon indication of smoke by a smoke detector, unit fans shall be de-energized via a hard-wired interlock. BAS shall also monitor the status of the individual smoke detectors and shall, via software, command the fans to stop, command the dampers to their NORMAL
positions, and enunciate appropriate alarm. Provide a smoke alarm reset button on the BAS workstation graphic to allow operator reset of the safety shutdown.

H. High or Low Pressure Safety: Upon activation of a high or low pressure safety switch at lead (or lag) circuit, the compressors at that circuit shall be de-energized, condenser fans serving that circuit, shall be de-energized via a hard-wired interlock. BAS shall annunciate appropriate alarm.

I. Run Time Limit Diagnostic: BAS shall accumulate the runtime of the status of associated rotating equipment (circuits, compressors, fans, etc.) and generate a Maintenance Alarm to indicate that the unit is in need of service.

3.4 ROOFTOP VARIABL AIR VOLUME AIR CONDITIONING UNIT (100% OSA, HOT WATER HEATING & DX COOLING COILS & EXHAUST FANS):

A. Design Intent:
   1. AC unit works as a variable volume unit, and feed variable volume air distribution systems which that covers multiple lab and non-lab spaces with air valve units.
   2. AC unit utilizes hot water heating coil, and completely independent dual circuit, HP cooling/heating coils and face and by-pass damper on outside air section.

B. Temperature Control:
   1. The unit shall maintain an occupied mode supply air of 55 degrees (adjustable and variable setting) and space temperature setpoint of 70 degrees (adjustable) with a separate heating and cooling deadband of +/-1 degree.
   2. Graphical adjustable temperature setpoint limits shall be provided to fix the (+) and (-) setpoint shift on the room sensor.

C. Face and By-pass Damper Control:
   1. Modulate the dampers in sequence with the DX cooling to maintain supply air temperature setpoint in a manner to minimize the load on refrigerant cooling.
   2. Modulate the dampers in sequence with the heating coil to maintain supply air temperature setpoint, or supply air temperature required for humidification, in a manner to minimize the load on heating coil.

D. Temperature Control (DX Cooling-By unit manufacturer):
   1. Enable the DX cooling to maintain supply air temp. setpoint of 55 degrees (adj.).
   2. Cycle and stage the DX cooling to maintain a proper supply air temperature.
   3. Ensure equal time operation for components in each cooling circuit (compressors, condensers fan, etc.)
   4. Provide adequate time delays or PID loop dampering to prevent short cycling of the DX compressor.
   5. Disable DX cooling if the outside air is less than 54 degrees.

E. Temperature Control (Heating/Heating&Humidification):
   1. Heating: Modulate the heating hot water control valve (Belimo EV) to maintain supply air temperature setpoint (55degrees adj.) or required heating setpoint for humidification (max.105deg.F. - adjustable).
   2. Enable heating function of heat pump system, when the unit is calling for heating for 10 continuous minutes (adjustable) and the required supply temp. (see above) is not met.
   3. Software shall have the capability to modulate heating control valve to maintain required supply temperature setting, if the operator chooses that option. For the units serving variable volume systems with multiple spaces via variable supply air valves, the maximum temperature setting shall be decided by space with least (minimum) heating load.
4. Enable the heating only if the space or all spaces served with the units are calling for heating or humidification for 10 continuous minutes (adjustable) and the outside air is less than (adjustable)

F. Exhaust Control:
1. The exhaust fan VFD shall enable and modulate to match the outside air flow signal. Provide an adjustable offset.
2. Modulate the VFD signal to meet the minimum and maximum requirements as stated in the schedules, see drawings.

G. Safeties:
1. Upon sensing a trip of:
   a) The smoke detector
   b) Low limit temperature safeties
2. Execute the following:
   a) De-energize the fan.
3. Reset: Provide software logic to reset the safeties shutdown as follows:
   a) System reset shall be automatic upon clearing of the following alarms:
      1) The smoke detector
   b) System reset shall be by Owner’s input for the following alarms:
      1) Low limit temperature safety

H. Points List:

<table>
<thead>
<tr>
<th>TAG</th>
<th>I/O TYPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-X Supply Fan S/S</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>AC-X Supply Fan Status</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alarm Command vs. Status Mismatch</td>
</tr>
<tr>
<td>AC-X Supply Fan VFD Signal</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AC-X Return/Exhaust Fan S/S</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AC-X Return/Exhaust Fan Status</td>
<td>X</td>
<td>Alarm Command vs. Status Mismatch</td>
</tr>
<tr>
<td>AC-X Return/Exhaust Fan VFD Signal</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AC-X Mixed Air Temperature</td>
<td>X</td>
<td>Alarm below 40 degrees</td>
</tr>
<tr>
<td>AC-X Return Air Temperature</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AC-X Discharge Air Temperature</td>
<td>X</td>
<td>Alarm 5 degrees above setpoint</td>
</tr>
<tr>
<td>AC-X Supply Volume</td>
<td>X</td>
<td>Locate volume probe in the intake of the fan</td>
</tr>
<tr>
<td>AC-X Return Volume</td>
<td>X</td>
<td>Locate the volume probe in the intake of the fan</td>
</tr>
<tr>
<td>AC-X DX Cooling</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>AC-X HW Valve</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AC-X Air Dampers</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>AC-X Freeze Detection</td>
<td>X</td>
<td>Critical Alarm</td>
</tr>
<tr>
<td>AC-X Smoke Detector(s)</td>
<td>X</td>
<td>Critical Alarm</td>
</tr>
</tbody>
</table>
3.5 VARIABLE VOLUME AIR VALVES (WITH HOT WATER REHEAT COILS):

A. Design Intent:
1. The unit manufacture shall provide these units with controls.
2. BAS contractor to install wiring, room sensors and controls for proper operation of all VAV valves (supply, rack, general and fume exhaust).
3. BAS contractor shall provide a Tridium JACE located in Elec./Data room. JACE shall have complete interface and access to laboratory air controls system, network and devices and act as the building Macro Server/Data Server and interface with all air valve control networks at room level and via their interface devices (Lon or BACnet).
4. A complete back up of the database should be provided to UNLV Facility Management for storage. Data base should be provided after installation and commissioning, for future reference.
5. BAS contractor shall provide locally-wall mounted interface device/panel (either I-pad or Tablet with real-time touchscreen monitor). This panel shall present all data related to room information, temperature, humidity, pressure relationship to corridor, and pressure relationship to adjacent space, as applicable (for prep and surgery rooms), etc. see minimum required point listed presented in section C below.
6. BAS BAS shall establish and manage the alarms from laboratories devices and controls, including excessive air flows.

B. Installation:
1. BAS contractor shall install the sash sensors, interface boxes, presence and motion sensor, and fume hood monitor on the fume hood under initial supervision of the Laboratory Air Controls System (LACS) supplier. Reel-type sash sensors and their stainless steel cables shall be hidden from view. Bar-type sash sensors shall be affixed to the individual sash panels or use of fixed sash sensors with take up reels is also permitted. Sash interface boxes with interface cards shall be mounted in an accessible location.
2. The BAS contractor shall install all Room Controllers and Room Integrators in an accessible location in or around the designated laboratory room.
3. The BAS shall install an appropriately sized and fused 24 VAC transformer suitable for NEC Class II wiring.
4. All cable shall be furnished and installed by the BAS contractor. The BAS contractor shall terminate and connect all cables as required. The BAS shall utilize cables specifically recommended by the laboratory airflow controls supplier.
5. All airflow control devices in the ductwork shall be installed by mechanical contractor and shall connect all airflow control valve linkages.
6. The mechanical contractor shall provide and install all reheat coils.
7. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.
8. System start-up shall be provided by a factory-authorized representative of the LACS manufacturer.
C. **Point list:** Table 1: Required (Min.) Laboratory Control Points for Interface to BMCS

<table>
<thead>
<tr>
<th>Unit-Device</th>
<th>Write Setting</th>
<th>Description-Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. SAV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Supply Air Valve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply CFM</td>
<td>Read only</td>
<td>Actual CFM valve is providing for temperature control</td>
</tr>
<tr>
<td>Offset</td>
<td>Read/Write</td>
<td>Maintains the proper balance of pressure in space</td>
</tr>
<tr>
<td>Space Pressure</td>
<td>Read/+or-</td>
<td>Indicates pressure in space in relation to corridor</td>
</tr>
<tr>
<td>Space Pressure</td>
<td>Read/+or-</td>
<td>Indicates pressure in space in relation to adjacent space (if applicable)</td>
</tr>
<tr>
<td>Supply Maximum CFM</td>
<td>Read/Write</td>
<td>Maximum cooling CFM set point</td>
</tr>
<tr>
<td>Supply Minimum CFM</td>
<td>Read/Write</td>
<td>Minimum cooling CFM set point</td>
</tr>
<tr>
<td>Cooling Demand</td>
<td>Read only</td>
<td>The actual cooling demand, displayed as 0 - 100</td>
</tr>
<tr>
<td>Heating Demand</td>
<td>Read only</td>
<td>The actual heating demand, displayed as 0 - 100, represents heating valve output</td>
</tr>
<tr>
<td>Mode</td>
<td>Read only</td>
<td>What mode Laboratory system in, Temperature control, unoccupied, etc.</td>
</tr>
<tr>
<td>Discharge air Temperature</td>
<td>Read only</td>
<td>Temperature of air supply</td>
</tr>
<tr>
<td>Current Lab Temperature</td>
<td>Read only</td>
<td>Laboratory temperature</td>
</tr>
<tr>
<td>Lab Temperature Set point</td>
<td>Read/Write</td>
<td>Laboratory temperature set point</td>
</tr>
<tr>
<td>Current Lab Humidity</td>
<td>Read only</td>
<td>Laboratory humidity ratio</td>
</tr>
<tr>
<td>Lab Humidity Set point</td>
<td>Read/Write</td>
<td>Laboratory humidity ratio set point</td>
</tr>
<tr>
<td>Device Alarm</td>
<td>Read only</td>
<td>Display English text of alarms</td>
</tr>
<tr>
<td><strong>B. GEV</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(General Exhaust Valve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust CFM</td>
<td>Read only</td>
<td>Actual CFM valve is exhausting, working inversely with HEV to provide proper pressure balance</td>
</tr>
<tr>
<td>Exhaust Maximum CFM</td>
<td>Read/Write</td>
<td>Maximum CFM set point, to maintain SAV offset</td>
</tr>
<tr>
<td>Exhaust Minimum CFM</td>
<td>Read/Write</td>
<td>Minimum CFM set point, to maintain SAV offset</td>
</tr>
<tr>
<td>Device Alarm</td>
<td>Read only</td>
<td>Display English text of alarms</td>
</tr>
</tbody>
</table>
### Table 1 Continued: Required Laboratory Control Points for Interface to BMCS

<table>
<thead>
<tr>
<th>Unit-Device</th>
<th>Write Setting</th>
<th>Description-Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. HEV</strong> (Hood Exhaust Valve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hood Exhaust CFM</td>
<td>Read only</td>
<td>Actual CFM valve is exhausting, working inversely with GEV to provide proper pressure balance</td>
</tr>
<tr>
<td>Hood Exhaust Maximum CFM</td>
<td>Read/Write</td>
<td>Maximum CFM set point, to maintain SAV offset</td>
</tr>
<tr>
<td>Hood Exhaust Minimum CFM</td>
<td>Read/Write</td>
<td>Minimum CFM set point, to maintain SAV offset</td>
</tr>
<tr>
<td>Sash position</td>
<td>Read only</td>
<td>Monitors sash position</td>
</tr>
<tr>
<td>Flow Alarm</td>
<td>Read only</td>
<td>Loss of flow alarm</td>
</tr>
<tr>
<td>Presence Sensor</td>
<td>Read only</td>
<td>Monitors hood use</td>
</tr>
<tr>
<td>Device Alarm</td>
<td>Read only</td>
<td>Display English text of alarms</td>
</tr>
<tr>
<td><strong>D. Laboratory Summary Data Display</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total SAV</td>
<td>Point generated by BMCS</td>
<td>Will totalize all SAV's in a specific lab, zone, or area</td>
</tr>
<tr>
<td>Total HEV</td>
<td>Point generated by BMCS</td>
<td>Will totalize all HEV's in a specific lab, zone, or area</td>
</tr>
<tr>
<td>Total GEV</td>
<td>Point generated by BMCS</td>
<td>Will totalize all GEV's in a specific lab, zone, or area</td>
</tr>
<tr>
<td>Excess (offset)</td>
<td>Point generated by BMCS</td>
<td>Will totalize all offset's from SAV's in a specific lab, zone, or area</td>
</tr>
</tbody>
</table>
3.6 Air conditioning units - MONITORING AND MANAGEMENT

A. General: The BAS shall monitor various aspects of the air condition systems and calculate parameters as specified below to facilitate operations and management.

B. Trending: The BAS shall continuously monitor, calculate and display the following parameters at the intervals indicated. These values shall be stored and reported per the trending requirements.

C. Parameters to be trended:
   1. All temperature sensors
   2. All relative humidity sensors
   3. All pressure sensors
   4. All run requests and statuses on a change in value
   5. All analog loop outputs
   6. Calculated wet bulb temperature
   7. Summed cooling and heating requests
   8. Monitor & control all exhaust fans.
   9. Exhaust fans shall start/stop per section 3.2 via BAS controls.
   10. All fans shall de-energize upon fire alarm.

3.7 SEQUENCES OF OPERATION:

A. This section provides the sequences of operation for each HVAC system. The organization of the sequences for each system are:

B. Design Intent:
   1. This contains a brief outline of the purpose and the design engineer's expectations for the system.

C. Sequences:
   1. The sequences are generally divided into smaller sequences for each component of the larger HVAC System.
   2. The concept is that each of these smaller sequences operates essentially independently, although together they integrate into the larger System.

D. Points Lists:
   1. The points list which describes the analog and digital inputs and outputs to the Building Automation System, shall be prepared by the Building Automation System Contractor and be submitted to the Engineer for review and approval.
   2. The points lists do not identify field interlocks and often times they will show a single Point that may control multiple field devices.
   3. The interlocks are identified in the written sequence.
   4. The number of field devices controlled shall be determined by the sizes of equipment scheduled on the mechanical drawings and the type of components selected by the Building Automation System Contractor. An example is damper actuators, the points lists will identify a single analog output point, the P&IDs may schematically show one or two actuators, but the size of the unit and the actuators dictates that multiple actuators are required.
   5. This base point list is presented as a minimum requirement and as a guideline. Building Automation System Contractor is responsible for providing complete sets of points that will satisfy the requirements of the sequence of operation and proper operation of the entire HVAC system.

E. Except as noted, total HVAC system shall be controlled by the full DDC system via automated temperature control system and central control module (Tridium JACE) located in the Data Room.
F. Space Temperature control (AC Unit)

1. Air Conditioning unit is energized and de-energized via central (BAS) DDC control system and shall operate continuously with their on board controls during occupied mode. AC unit shall operate as a variable air flow system and shall be controlled, to maintain supply air temperature setpoint (55degreeF, adjustable). Cooling, heating, humidification, etc. enables/modes shall be automatically activated by BAS as needed and as described in this section to satisfy the respective space requirements. Unit shall provide 55 degrees (adjustable) supply air temperature (via face&by-pass damper and/or DX coil function). Individual space temperature settings shall be met by means of modulating heating control valve at supply air valve reheat coils. The space temperature in Elec./Data room shall be met by modulating supply air valve air flow only and its respective general exhaust valve, ensuring adequate design offset is met.

BAS shall only enable cooling mode. The unit controller (provided and installed by unit manufacturer) shall control and maintain the discharge air temperature settings in cooling mode, via sequencing and staging unit compressors. All variable flow refrigerant controls, optimization, sequencing of compressors, staging, dual circuit operation and controls, safety and alarm shall be maintained and controlled by the unit manufacturer's controller. Unit controller shall transmit via BACnet cooling operation data and alarms to BAS through a factory installed terminal board/buss. BAS shall provide the discharge sensor and transmit to JACE via BACnet both the measured sensor value and the desired set point. BAS shall monitor to ensure proper supply and exhaust relationships (to include the offsets) are provided for proper pressures relationship. BAS shall install adequate differential pressure sensors, temperature and humidity sensors at critical locations for monitoring and verifying building operation.

2. AC unit is equipped with a “Face and By-pass” assembly on outside air section. BAS shall install damper actuators and actuate the dampers to maintain proper mixed air temperature downstream of the heat recovery section to minimize use of energy for both cooling and heating cycles, and maintain supply air temperature setting (55deg.F, adjustable).

3. BAS shall control supply fan array speed control via VFD to maintain total supply CFM demanded by lab air valves control systems. BAS shall also control exhaust fan array speed via VFD and by-pass, to maintain total exhaust CFM demanded by lab air valves (general, hood and rack exhausts), and to maintain building total/overall offset. BAS shall monitor supply duct static pressure, and verify supply and exhaust airflow CFM via air flow measurement stations at each fan array (supply and exhaust). The flows shall be adjusted to maintain an established delta between the supply air and return air (offset).

4. BAS shall initiate the hydronic heating section, modulate Belimo EV valve, and ultimately process the heating sequence to maintain unit supply air setpoint. BAS shall transmit EV valve data and alarm to EMS. BAS shall enable heating function of heat pump system, when the unit is calling for additional heating for 10 continuous minutes (adjustable) if the required supply temperature could not be met by hydronic heating coil.

5. Humidification:
   a. Heating: BAS shall initiate heating mode, and command “HIGH PRESSURE WATER ATOMIZATION TYPE EVAPORATIVE HUMIDIFICATION SYSTEM” to start pumping RO water into humidifier section of the AC unit to maintain space humidity as and when needed. Refer to section 15750.
   b. Cooling: BAS shall initiate humidifier section and inject RO water into 55degreeF supply air stream as needed, and as described below to maintain space humidity at 30%.
   c. Sequence shall include psychometric calculations to calculate the leaving air temperature from heating coil in order to maintain space RH at minimum of 30% (maximum 50%, adjustable), utilizing minimal cooling energy. BAS shall monitor and control humidification process as described below, to maintain desired humidity levels at the space level.
1) Most critical labs spaces,
2) The discharge duct (used for safety, hi-limit shutoff),
3) Outside air humidity (for monitoring total humidification process),
4) And return/exhaust (duct from space) to monitor overall humidity levels.

6. Air conditioning unit, shall be de-energized as a first priority by its respective smoke detector on supply air duct. Smoke detector shall be provided by Division 16, installed and wired by air conditioning unit manufacturer. All air moving devices shall completely and automatically shut down once smoke is detected by its’ smoke detector. The smoke detector shall be wired to shut down air moving devices and not shut down (disable) the entire unit and its control module.

7. Manual volume dampers shall be installed only where shown on the drawings on supply, return air duct and on outside air duct of all air handler units to facilitate the balance of the system.

8. BAS shall have complete interface to the Lab Air Controls Systems (LACS), and use the data transmitted from LACS (via JACE) to adequately operate and sequence the AC unit to satisfy lab spaces below.

9. BAS shall establish and manage the alarms. BAS should provide temperature and status alarms for air handler, supply and exhaust systems, and laboratories devices and controls, including excessive air flows.

G. Miscellaneous Controls:
1. BAS shall receive alarm signal (input) from Fire Alarm control panel (FACP) and transfer to front end with proper graphics. Coordinate with division 16.
2. BAS shall receive alarm signal (input) and transfer to front end with proper graphics when power is switched to emergency power. Coordinate with division 16.
3. BAS shall coordinate between division 16 contractor and UNLV Office of Information Technology, to ensure a “certified” cat 5 or cat 6 cable is installed from Belimo energy valve at the AC unit on roof, down to Data Room, below and install Ethernet port for connection of the cable directly to the EMS network. BAS shall provide adequate graphics to monitor the data received from the EV valve, by EMS department.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.

B. Division 15 Section "Instrumentation and Controls" for control equipment and devices and submittal requirements.

C. Division 15 Section "Sequence of Operation" for requirements that relate to this Section.

D. Division 15, Section "Building Commissioning for required coordination with the Commissioning Authority. This system will be commissioned by an outside authority after all startup procedures specified under this section are completed.

E. Division 15, Section "Testing, Adjusting and Balancing" required coordination with the Testing, Adjusting and Balancing Contractor (TAB). TAB will be accomplished by an independent contractor after all startup procedures specified under this section are completed.

F. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK DESCRIPTION

A. This Section includes all systems integration requirements for the Multiple System Integration Platform (MSIP).
   1. This includes all required hardware, software, database, graphics generation, ethernet communication, and internet communication for connection of the Building Automation System (BAS) provided under Division 15 section HVAC Instrumentation and Controls to the MSIP provided under this section.
   2. The BAS provider shall provide a stand-alone system utilizing BACnet protocols and connection to the UNLV ethernet Wide Area Network.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Division 15 Section "Sequence of Operation" for requirements that relate to this Section.

1.4 DEFINITIONS

A. DDC: Direct-digital controls.

B. CV: Constant Volume

C. MSIP: Multi-System Integration Platform

D. MZ: Multizone

E. BAS: Building Automation System

F. AI: Analog Input
G. AO: Analog Output
H. DI: Digital Input
I. DO: Digital Output
J. I/O: Input/Output
K. PID: Proportional-Integral-Derivative
L. JACE: Java Application Control Engine.
M. PICS: Protocol Implementation

1.5 QUALIFICATIONS

A. Installer Qualifications: Documented factory training on the MSIP software.
B. Approved Manufacturers of the Multiple System Integration Platform (subject to specification requirements) as per UNLV requirement and standards.
C. Installer Qualifications:
   1. The control system shall be furnished, engineered, and installed by a factory trained systems integrator.
   2. Provide factory-trained technicians for instruction, routine maintenance, and emergency service within twenty four (24) hours upon receipt of request.
   3. Company specializing in installing and performing the work specified in this section with a minimum of (3) years documented experience.
D. Control system components shall be new and in conformance with the following applicable standards for products specified:
   1. ASME MC85.1 - Terminology for Automatic Control.
   2. Institute of Electrical and Electronic Engineers, IEEE
   5. FCC Regulation, Part 15, Section 156
   8. ASHRAE 135 for DDC system control components.
   9. Underwriters Laboratory, UL 916
   10. Local building codes

1.6 SUBMITTALS

A. General:
   1. All submittal requirements specified shall be provided as a single complete package, bound in a 3 ring binder.
   2. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
   3. A partial submittal consisting of a damper and valve schedule will be accepted for projects with short construction schedules, provided a written request is submitted and approved by the engineer.

B. Drawings: The systems integrator contractor shall submit schematic drawings in hardcopy and electronic media, for review and approval before work shall begin. The hardcopy drawings shall be submitted on 8-1/2" x 11" or 11" x 17" sheets with drawing information sized such that all drawing information is legible. The submittal drawings shall include the following:
1. A network diagram depicting the system architecture complete with a communications riser and peripheral devices. Update the architecture to include all existing systems integrated into the MSIP. Identify all IP address and school names. Provide a connection detail to the BAS system.

2. Graphics:
   a. Provide color printouts of all specified graphic files including equipment schematics, tabular equipment data and floor plates. Consult with UNLV Environmental Services Department (ESD) for Graphical Standards prior to development of graphic screens.

3. Database Standards:
   a. Provide a printout of database standardized naming conventions for all inputs, outputs, setpoints and adjustable parameters.
   b. For example, Air Handling Unit will be reduced to AH and discharge air temperature will be reduced to DA-T such that the database will reflect a name of AH1 DA-T. Contact UNLV ESD for a listing of a Database Nomenclature Standards.
   c. This portion of the submittal may be submitted after approval of all hardware, but shall be provided prior to installation of the network controller.

C. Technical Data:
   1. The submittals shall include manufacturers catalog data describing each item of control equipment or component provided and installed for the project.
   2. Include and identify all data needed to show adherence to the corresponding specification section.

D. Integration Database:
   1. Review the BAS contractor provided detailed tabulated database cross-referencing each BACnet or Lon object, including all inputs, outputs, alarms, schedules, setpoints, trends, and adjustable parameters.
   2. Provide an additional tabulated database cross-referencing MSIP required parameters with the BAS database.

E. Specification Compliance:
   1. The submittals shall include a specification compliance analysis in a separate tabbed section of the submittal, for review and approval before work shall begin.
   2. The compliance document shall address each paragraph of Part 1, Part 2, & Part 3 of this section, by indicating COMPLY, or EXCEPTION.
   3. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement.
   4. If EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the effect this has on the specified system performance. CCSD shall retain the right to accept or deny any listed exceptions to the specification.
   5. All approved bidders shall submit a complete specification compliance.

1.7 SOFTWARE LICENSING

A. It is assumed that Master Site and other required Licenses exist.

1.8 WARRANTY

A. Existing
PART 2 - PRODUCTS

2.1 MULTIPLE SYSTEM INTEGRATION PLATFORM (MSIP)

A. General:
   1. The Multiple System Integration Platform shall be capable of total integration of the
      facility infrastructure systems with user access to all system data either locally over a
      secure Intranet within the building or by remote access by a standard Web Browser over
      the Internet.
   2. This shall include HVAC control, electrical, gas and water metering, energy
      management, alarm monitoring / management, security and personnel access control,
      fire / life safety, and all trending, reporting and maintenance management functions
      related to normal building operations.

B. Tridium Niagara Framework Specific Requirements:
   1. The integrator shall connect all supplied “Jace” Hardware, to the UNLV common Web
      Supervisor which shall be licensed to access all suppliers “Jaces”. The Web
      Supervisor shall be configured to provide the Master Scheduling, Logging, Trending,
      Alarming, and Maintaining the Niagara Framework system for each school.
   2. The system shall be configured to disallow unauthorized access from suppliers to
      equipment installed by other suppliers, other than through UNLV Web Supervisor with
      username and password.

C. System Expansion:
   1. The installed system must be totally extendable to allow for future expansion with the
      addition of controllers and / or input / output devices. It shall not be necessary to remove
      equipment supplied under this contract to expand the system.

D. System Failure:
   1. The failure of any single component or network shall not interrupt the control functions of
      non-affected devices.
   2. A single network failure shall only affect shared communications or shared data; individual
      application controllers and Network Area Controllers shall continue normal operation minus
      only the data from a remote device from the affected network.
   3. Automatic default values for all network-transported data shall be provided to allow
      continued operation until the network is restored.

E. Battery Backup:
   1. Provide surge protection (minimum 2000 Joule) and a 15-minute (minimum 650 VA)
      uninterruptible power supply for each main system controller, L.E. JACE, LGE, etc.

F. Integration:
   1. The supplied system shall provide adherence to industry standards including ANSI /
      ASHRAE Standard 135-1995, BACnet and LonMark to assure interoperability between all
      system components is required.
   2. The system supplier must provide a PICS document showing the installed systems
      compliance level. Minimum compliance is Level 3.

G. Database:
   1. The supplied system must incorporate the ability to access all data using Java enabled
      browsers without requiring proprietary operator interface and configuration programs.
   2. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant
      server database is required for all system database parameter storage.

H. Communication Architecture and Event Response:
1. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 15 seconds for network connected user interfaces.

2.2 GRAPHICAL INTERFACE

A. General:
1. A graphical user interface shall provide, through proper password access, full interaction with the system including, but not limited to, viewing and modifying data, database administration, configuration of communications parameters, password and security administration, programming and configuration of objects, receipt, routing and acknowledgment of alarms, and development of graphic screens.

2. The windowing environment shall allow the operator to open or close windows by use of a pop-up menu selection and manipulate data or graphics in each of the open windows.

3. The windowing environment shall allow dynamic display of the data in each of the open windows with no degradation to overall graphic performance.

4. Provide a minimum of 1024x768 resolution.

B. User Interface:
1. The user interface shall employ browser-like functionality for ease of navigation. It shall include a tree view for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu pull downs, and toolbars shall employ buttons, commands and navigation techniques similar to those in a commercially available Web Browser.

2. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), which displays the location and object id of the selected object.

C. Alarm console
1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm.

2. A separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms.

D. Color Graphic Editor:
1. Graphic screens shall be developed using any drawing package capable of generating a .GIF, .BMP, or .JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background, the user interface shall support the use of scanned pictures.

2. Graphics developed for the user interface shall be capable of being used by a standard Web Browser client, without the need to develop additional graphic screens specifically for the Web Browser. Graphics used by the Web Browser client(s) shall be capable of being edited using a standard HTML document editor.

3. Graphic screens shall have the capability to be overlaid with text, real-time values, command and adjust, animation, color spectrum, logs, graphs, HTML document links, and schedule graphic objects, as well as links to other graphic screens.

E. Graphical Manual Control:
1. By clicking on the graphical object, the operator shall be able to:
   a. Turn points on or off
   b. Start or stop points
   c. Adjust values of control loop outputs
   d. Adjust analog outputs
   e. Adjust set points
f. Change points to local mode or release points to automatic mode.

2. Provide graphical adjustment of all common application objects, such as schedules, calendars, and setpoints.
   a. Provide manual graphical start stop control of all binary objects. Commands issued to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
   b. Provide manual graphical adjustment to all analog objects. Adjustments to analog objects, such as setpoints, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

F. Graphic Standards: Shall be per latest UNLV requirements and standards.

G. Database Nomenclature Standards:
   1. UNLV database nomenclature standards shall be obtained from ESD. Any database provided that does not comply with this standard shall be modified.

H. Graphics Display:
   1. Provide a graphical general information tabular style text screens that summarize all data for that HVAC system on a single screen in a customized form.
   2. Information on the color graphic display shall be dynamic and automatically updated.
   3. All control sequence setpoints and setpoint resets used shall be included on the equipment graphic.
   4. These diagrams shall include all control setpoints, ranges, and scales which are dynamically displayed and may be adjusted on-line.
   5. Program the software such that this display is only accessible by operators with a password that allows programming changes.
   6. Graphical manual override shall be provided for all input output points connected to the BAS system.

I. Graphics Library: The library shall include control objects for the following functions at a minimum:
   1. Analog Input Object:
      a. Minimum requirement is to meet the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming.
      b. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
   2. Analog Output Object:
      a. Minimum requirement is to meet the BACnet standard for data sharing.
   3. Binary Input Object:
      a. Minimum requirement is to meet the BACnet standard for data sharing.
      b. The user must be able to specify either input condition for alarming.
      c. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an on condition.
      d. The user must be able to specify either input condition as the Aon® condition.
   4. Binary Output Object:
      a. Minimum requirement is to meet the BACnet standard for data sharing.
      b. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided.
      c. The BACnet Command Prioritization priority scheme must also be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked.
      d. Provide sixteen levels of priority as a minimum. Systems not employing this contention resolution shall not be acceptable.
   5. PID Control Loop Object:
      a. Minimum requirement is to meet the BACnet standard for data sharing.
      b. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
6. Comparison Object:
   a. Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs.
   b. Also, allow limits to be applied to the output value for alarm generation.

7. Math Object:
   a. Allow a minimum of four analog objects to be tested for the minimum or maximum, sum, difference, or average of linked objects.
   b. Also, allow limits to be applied to the output value for alarm generation.

8. Custom Programming Objects:
   a. Provide a blank object template for the creation of new custom objects to meet specific user application requirements.
   b. This object must provide a simple BASIC-like programming language that is used to define object behavior.
   c. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum.
   d. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object.

9. Interlock Object:
   a. Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as a rooftop unit or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object.
   b. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the rooftop unit is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the rooftop unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

10. Temperature Override Object:
    a. Provide an object whose purpose is to provide the capability of overriding a binary output to an "on" state in the event a user specified high or low limit value is exceeded.
    b. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

11. Composite Object:
    a. Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications.
    b. This object must have the ability to allow the user to select the appropriate parameters of the contained application that are represented on the graphical shell of this container.

2.3 WEB BASED OPERATOR INTERFACE

A. Text Interface:
   1. A text interface shall be provided that allows customers to access their BAS data via the Internet or Intranet.
   2. This interface shall use HTML-based pages to send and receive data from a BAS system to a web browser.

B. Web Browser Support:
   1. The system shall support an unlimited number of clients using a standard Web Browser such as Internet Explorer™ or Netscape Navigator™.
C. Web Browser Client Functionality:
   1. User log-on id and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication techniques to prevent unauthorized access shall be implemented.
   2. Graphical screens developed for the user interface shall be the same screens used for the Web Browser client. Storage of the graphical screens shall be in the system, without requiring any graphics to be stored on the client machine.
   3. Depending on user access privileges, the user shall be able to view data, modify and command objects such as start/stop, and adjust setpoints. In addition, users can be provided with the ability to view logs and view and acknowledge alarms.
   4. The system shall provide the capability to specify a user’s (as determined by the log-on user (ID) home page. The capability to limit the user to just their home page shall be provided. From the home page, links to other views, or pages in the system shall be possible.
   5. Graphic screens on the Web Browser client shall support hypertext links to other Web pages on other Internet or Intranet sites.

PART 3 - EXECUTION

3.1 GENERAL

A. Control:
   1. All HVAC Systems shall be controlled through the MSIP according to the point list contained in section 15980 of the specifications.
   2. Additional points or software programming not listed in the point list but which are required to meet the following sequences of operation shall be provided.

B. Database Archive:
   1. The database for all MSIP graphics and points shall be stored within a controller on-site. Any changes to this database shall be re-archived with a revision date and distributed to UNLV.
   2. A backup of ALL databases for all devices (Dedicated, General, and Network) shall be provided to UNLV ESD. Any changes to these databases shall be re-archived with a revision date and distributed to UNLV ESD.

C. Control Parameters:
   1. All setpoints and control parameters shall be adjustable both from the desktop workstation and portable workstation primary operator interface software, without any required re-programming of software code. Provide graphical remote lockout of each room sensor setpoint adjustment dial.
   2. All control loops shall utilize PID control algorithms unless otherwise specified in the sequence of operation.

D. Alarms:
   1. All specified I/O critical and maintenance device alarms shall be annunciated at the MSIP system workstation and workstation printer. Provide alarm messages tailored for the alarm by building, system type and device type (i.e., “High Discharge Air Temperature”).
   2. All system alarms shall be interlocked to only alarm when the associated system is enabled. For example, do not alarm discharge air temperature when the air handling system is off. Alarms based on room temperature shall always be annunciated.
   3. The following alarms on any system shall be critical:
      a. Refrigerant leak detection alarm
      b. Smoke detector alarm
      c. Room temperature alarm below 50 degrees.
      d. Chiller failure alarm
   4. Alarms shall have the capability of being prioritized at owner discretion.
   5. Points that are in alarm shall be in red text on their corresponding graphics screen.
**E. Trending:**
1. Provide simultaneous trending of the following:
   a. All analog input and output values.
   b. All digital input and output values.
   c. All setpoints.
2. Group the trend values in a logical way.
   a. Group control loops values together. An example would be an RTU discharge air
temperature with the analog temperature input, output(s) to the controlled device(s)
and PID control loop setpoint on the same trend.
   b. Group zone temperatures, setpoints and zone dampers together.
3. Each analog trend shall be trended at 15 minute intervals with a minimum of 288 samples
(3 days).
4. Each digital trend shall be trended based on a change of state.
5. Each trend and trend group shall be uploadable into a Microsoft Excel spreadsheet.

**F. Graphics Display:**
1. All graphics screens shall conform to UNLV graphical standards.
2. Provide a graphical general information tabular text data graphic screens that summarize all
data for that HVAC system on a single screen in a customized form.
3. Information on the color graphic display shall be dynamic and automatically updated.
4. These diagrams shall include all control setpoints, ranges, and scales which are
dynamically displayed and may be adjusted on-line.
5. Program the software such that this display is only accessible by operators with a password
that allows programming changes.
6. Graphical manual override shall be provided for all input output points connected to the
BAS system.
7. Provide sufficient links between graphic displays to provide a maximum of two mouse clicks
to get from any one graphic to any other graphic.

**G. Sequences of Operations Graphics:**
1. Provide a graphics screen with a written sequence of operation for each HVAC system with
a link to the associated graphics screen.
2. For each setpoint described in the sequences of operation, provide a dynamic reading that
displays the actual setpoint value.
3. Provide a “Documents” screen that shall include the Sequence of Operation, Programming
Flow charts, As-builts, and any related technical/spec sheets for the entire HVAC system.

**H. Floor Plan Graphics:**
1. Provide floor plans showing floor partitions and space mounted sensor locations located on
the floor plan.
2. Provide indication of:
   a. All zone input/output points.
   b. Outside air temperature on each graphic.
   c. Provide temperature setpoint adjustments for each zone.
   d. Provide links to associated rooftop unit systems.
   e. Provide links to associated air handling rooftop systems.
   f. Provide links to all central plant screens.

**I. Rooftop Unit System Graphics:** Provide tabular text data graphics including, but not limited to:
1. Indication of:
   a. All input/output points.
   b. Outside air.
   c. All associated zone temperatures and links to floor plan.
   d. Links to all central plant screens.
2. Manual on-off-automatic switch for the system occupied/unoccupied mode with adjustable
timer.
4. Manual adjustment with a Manual/Automatic setting for all adjustable parameters including, but not limited to:
   a. Room temperature setpoints.
   b. Discharge air temperature setpoint reset limits (as applicable)
   c. Heating temperature setpoint reset limits (as applicable)
   d. Cooling temperature setpoint reset limits (as applicable)
   e. Economizer outside air temperature lockout setpoint (single point for all HVAC systems)
   f. Relief fan energize percentage setpoint

J. DX Cooling System Graphics: Provide tabular text data graphics including, but not limited to:
   1. Indication of all input/output points.
   4. Manual adjustment with a Manual/Automatic setting for all adjustable parameters including, but not limited to:
      a. System operation enable/disable from OSA temperature setpoint.
      b. Cooling system start/stop from cooling demand setpoint.
      c. Supply temperature reset setpoint limits.

K. Heating Water System Graphics: Provide tabular text data graphics including, but not limited to:
   1. Indication of all input/output points.
   4. Manual adjustment with a Manual/Automatic setting for all adjustable parameters including, but not limited to:
      a. Heating water system operation enable/disable from OSA temperature setpoint.
      b. Heating water system start/stop from cooling demand setpoint.
      c. Heating water supply temperature reset setpoint limits.

L. Miscellaneous Graphics:
   1. Graphical setpoint adjustments in addition to those listed above shall be provided (i.e. pressure, humidity, etc.) when noted in the sequence.

END OF SECTION
SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Testing, Adjusting, and Balancing HVAC systems shall be performed by a specialized firm.

C. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including sub mains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   5. Reporting results of the activities and procedures specified in this Section.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 1 – Quality Control
B. Division 1 – Testing Laboratory/Agency Services
C. Division 1 – Starting of Systems
D. Division 1 – System Demonstration
E. Division 1 – Testing, Adjusting, and Balancing
F. Individual Sections: Qualification of testing organization; specific services required. Where there is any conflict of services or directions between Sections regarding the Testing and Balancing of Systems, contact the Architect immediately.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high Air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person’s skin than is normally dissipated.

D. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a Closed system, static head is equal on both sides of the pump.

E. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
F. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

G. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

H. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

I. Test: A procedure to determine quantitative performance of a system or equipment.

J. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.


M. CTI: Cooling Tower Institute.

N. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

A. Refer to Div. 1 – Submittal Procedures, for submittal requirements.

B. Draft Reports: prior to commencing work, submit a detailed agenda of balancing procedures for this project. Include a draft report utilizing proper and relevant report forms appropriate to the procedures. The forms shall be essentially completed with design criteria and approved performance data of the equipment approved for use. This shall be representative of the information to be included in the final report. Accompanying this agenda/draft report shall be a complete set of approved performance submittal data on equipment relevant to the HVAC systems, etc. Also, submit the AABC National Project Performance Guarantee, or the acceptable equivalent thereof.

C. Test Reports: Prior to the final acceptance of the project, submit for approval and for inclusion into the operating and maintenance manuals. Provide the report in six copies, letter size, spiral-type (3-ring for larger reports) permanent binder, with index page, tabs, with cover identification. The report shall also include a significant General Comments section identifying unusual or incomplete final conditions that could not be remedied fully or satisfactorily. This shall also summarize such significant data that may appear on individual test data sheets. Included in the report shall be reduced scale drawings with air outlets and equipment identified to correspond to the data sheets but also the final as-built, contract drawings with respect to mark numbers, room numbers and other significant physical I.D., etc. Also show final locations of thermostats, sensing elements and duct traverses. The report shall provide evidence that all reasonable efforts on the part of the TAB and the related trades shall have been performed sufficiently to remedy any remaining deficiencies. The report shall include an appendix with copies of all Site Inspection Reports (or equivalent thereof) issued by the TABA and the responses by any and all parties, relevant to the Inspection Reports. In addition, shall there have been RFI’s &- Change Orders affecting the TAB work, they shall be included.

D. Copies of the approved performance curves, charts, etc., on all fans, coils, RTU’s, etc. shall be included in a separate section or appendix of the TAB report. It is the responsibility of the Architect and Consulting Engineer to provide “approved” copies of the appropriate submittal/performance data of the equipment involved in the installation. They shall also provide copies of the appropriate drawings and specifications, addenda, change borders, etc.,
required by the TABA to perform their work.

E. Report Forms: Forms utilized shall be significantly similar to the forms of the AABC National Standards.

1.5 QUALIFICATION AND QUALITY CONTROL

A. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and the AABC Procedures Manual; these shall be considered the minimum criteria. Agencies shall be certified by AABC and all work shall be performed under the direct field supervision of an AABC certified TBE.

B. The successful TABA shall be immediately provided with the necessary contract drawings, approved submittal data, etc., required to enable their critique of the contract drawings, addenda and specifications with respect to determining the “balance-ability” of the systems. This report shall be given to the Owner, Architect and Engineer. The TABA shall expedite this important aspect of TAB services.

1.6 GENERAL SCOPE OF WORK

A. Testing, Adjusting and Balancing of the heating, ventilating and air conditioning (HVAC) systems.

B. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and shall be considered the minimum criteria. These Standards are to be used and applied on the appropriate scope of the systems utilized and installed in and on this project. The TABA shall be totally familiar with these Standards and further detailed directions will not be provided unless specifically stated herein.

C. Test & Balance Agencies (TABA) shall be certified by the AABC, and all work shall be performed under the direct field supervision of an AABC certified TBE. All TABA firms shall have a permanent office in So. Nevada, locally manned with certified personnel and a Test & Balance Engineer. The TABA shall have been a member agency in good standing with their association for a minimum of three (3) years.

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.8 COORDINATION

A. Contractor and the Contractor’s representatives shall coordinate the systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. BAS, Commissioning/Lab Air Valve Control Agency will coordinate with TABA.

1.9 RESPONSIBILITY OF CONTRACTOR
A. Should the TABA be unable to perform his work or be required to redo his work because HVAC System(s) (elements, components or subsystems) are not ready or are improperly installed, any additional costs, herein related and approved by the owner, shall be back charged to the Contractor.

B. Contractor and all Sub-Contractors shall cooperate fully with the TABA to efficiently complete the systems and their balancing.

C. Other than their instrumentation, gauges, etc., the TABA shall not provide nor install any devices or components. It is the responsibility of the Contractor to ensure the necessary assistance and coordination is provided which shall include (but not limited to):
   1. Calibration of all controls (includes providing of instrumentation and software necessary to the operation of same, i.e. computers, etc.), providing and installing of drives, dampers, filters, access, test holes, gauges and taps (properly located), sealing of holes and insulation, removal and replacement of ceiling and/or tiles, water systems cleaned and flushed, duct leakage and pressure testing, proper motor starters and heaters installed, volume, fire and smoke/fire dampers, diffusers, grilles. All duct-mounted dampers shall be placed and locked in a full open position and clearly “flagged” for ease of location. The ceiling tile shall be clearly and permanently ID’ed, for everyone’s knowledge of access. Hard ceilings shall be provided with permanent access. Where required the contractor(s) shall provide the necessary and adequate lifts and scaffolds.
   2. All systems shall be checked, tested and started prior to turning them over to the TABA, and the report of same, in writing, provided to the TABA, as well as the owner. Contractor shall have a competent technician or tradesmen available during the testing and balancing of the systems. There shall be an HVAC technician, fully familiar with the systems, on site full time during the work of the TABA.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine strainers for clean screens and proper perforations.

F. Examine control valves for proper installation for their intended function of fluid flows.

G. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

H. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

I. Examine equipment for installation and for properly operating safety interlocks and controls.

J. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

K. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices operate by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in AC unit, and variable-air-volume air valve units.
   4. Automatic modulating and shutoff valves, including 2-way valves are properly connected.
   5. Sensors are located to sense only the intended conditions.
   6. Sequence of operation for control modes is according to the Contract Documents.
7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
8. Interlocked systems are operating.
9. Changeover from heating to cooling mode occurs according to design values.

1.10 REPORT FORMS

A. Submit reports on AABC National Standards for Total System Balance.

B. Forms shall include the following information:
   1. Title Page:
      a. Company name
      b. Company address
      c. Company telephone number
      d. Project name
      e. Project location
      f. Project Engineer
      g. Project Contractor
      h. Project altitude
   2. Instrument List:
      a. Instrument
      b. Manufacturer
      c. Model
      d. Serial number
      e. Range
      f. Calibration date
   3. Air Moving Equipment:
      a. Location
      b. Manufacturer
      c. Model
      d. Air flow, specified and actual
      e. Return/Exhaust air flow, specified and actual
      f. Outside/Supply air flow, specified and actual
      g. Total static pressure (total external), specified and actual
      h. Inlet pressure
      i. Discharge pressure
      j. Fan RPM
   4. Return/Exhaust Air-Outside/Supply Air Data:
      a. Identification/location
      b. Design air flow
      c. Actual air flow
      d. Design return/exhaust air flow
      e. Actual return/exhaust air flow
      f. Design outside/supply air flow
      g. Actual outside/Supply air flow
      h. Return/exhaust air temperature
      i. Outside/Supply air temperature
      j. Required mixed air temperature at face and by-pass dampers
      k. Actual mixed air temperature at face and by-pass damper
      l. Design supply/exhaust air ratio
      m. Actual supply/exhaust air ratio
      n. VFD status (% or Hz)
   5. Electric Motors:
      a. Manufacturer
      b. HP/BHP
      c. Phase, voltage, amperage; nameplate, actual, no load.
      d. RPM
6. Cooling Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Entering air DB temperature, design and actual
   g. Entering air WB temperature, design and actual
   h. Leaving air DB temperature, design and actual
   i. Leaving air WB temperature, design and actual
   j. Air pressure drop, design and actual

7. Heating Coil Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Entering air temperature, design and actual
   g. Leaving air temperature, design and actual
   h. Air pressure drop, design and actual
   i. Water flow, design and actual
   j. Water pressure drop, design and actual
   k. Entering water temperature, design and actual
   l. Leaving water temperature, design and actual

8. Humidification Section Data:
   a. Identification/number
   b. Location
   c. Service
   d. Manufacturer
   e. Air flow, design and actual
   f. Entering air temperature (DB and WB) and RH, design and actual
   g. Leaving air temperature (DB and WB) and RH, design and actual
   h. Air pressure drop, if any, design and actual
   i. RO Water flow, design and actual

9. 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

10. Air Distribution Test Sheet:
    a. Air Valve terminal number (supply, general exh., rack exh. And hood exh.)
    b. Fume Hood air flow (face velocity, sash open and close)
c. Room number/location
d. Terminal type
e. Terminal size
f. Area factor
g. Design velocity
h. Design air flow
i. Test (final) velocity
j. Test (final) air flow
k. Percent of design air flow

11. Space Pressure Differential Test Sheet:
   a. Room number/location and space required pressure (positive and/or negative)
   b. Air Valve terminal number (supply, general exh., rack exh. And hood exh.) and air flow
c. Fume Hood number and air flow
d. Rack exhaust air flow
e. Design and actual air flow via corridor
   f. Design and actual air flow via adjacent space (Prep-Surgery)
g. Percent of design air flow

12. Reheat Coil Data:
   a. Identification/number
   b. Location
c. Service
d. Manufacturer
e. Air flow, (min-max) design and actual
   f. Entering air temperature, design and actual
g. Leaving air temperature, design and actual
   h. Water flow, design and actual
   i. Water pressure drop, design and actual
   j. Entering water temperature, design and actual
   k. Leaving water temperature, design and actual

1.11 WARRANTY

A. General Warranty.

B. Provide one-year full warranty from date of, Substantial Completion.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 1 Section "Project Record Documents."
D. Examine system and equipment test reports.

E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing, and Report all deficiencies to Architect/Owner.

G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine air valve terminal units, to verify that they are accessible and their controls are connected and functioning.

I. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures to Architect/Owner.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures:
   1. Before commencing work, as best as can be done, verify that systems are complete, operable and ready to balance. The TABA shall not begin their work until they (and the Owner) have received, in writing, from the installing contractors and the commissioning agency, that all of the systems have been completed, checked, tested and started and are completely ready for the TABA to begin their work.

B. The TABA shall make a minimum of three (3) site inspection visits during the systems installation. A written report (Site Inspection Report) of these inspections shall be sent to the Owner, Architect, Consulting Engineer and Contractor(s).

C. During the course of the work performed by the TABA, they shall provide Site Inspection Reports, daily if necessary, which shall report any defects, deficiencies or abnormal conditions observed in the systems, which may prevent systems balance, or compromise the proper operation of the systems. These reports shall be sent via fax, Email, by the following workday, to the Owner, Architect, Consulting Engineer and Contractor(s). Additionally, the prime Contractor shall provide a three-ring binder, on site, wherein copies of these reports/inspections shall be placed for the use of the contractors, inspectors or others.

D. Each of the above-notified parties shall document acceptance and receipt of these Reports by signing same, and returning that document to the owner or his representative and the TABA.

E. Recorded data shall represent actually measured or observed conditions and appropriate ambient conditions.

F. The intent and goal of testing and balancing is to have a completed system(s) functioning per design and has no deficiencies. The fullest cooperation between the TABA, BAS, Commissioning Agency and the Contractor and his trades is essential.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
B. The TABA shall permanently mark settings of valves, dampers and other adjustment devices. 
Set and lock memory stops and mark them. Mark equipment settings with paint or other 
suitable, permanent identification material, including damper-control positions, valve indicators, 
fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 
3-ring binder (6 copies), tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and 
balancing Engineer.

C. Include a list of the instruments used for procedures, along with proof of calibration.

D. Final Report Contents: In addition to the certified field report data, include the following:
1. Fan curves.
2. Manufacturers’ test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include approved Shop 
   Drawings and Product Data.
5. All sight inspection and deficiency reports done by TABA.

E. General Report Data: In addition to the form titles and entries, include the following data in the 
final report, as applicable:
1. Title page.
2. Name and address of testing, adjusting, and balancing Agent.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer’s name, address, and approval stamp.
7. Contractor's name and address.
9. Signature of testing, adjusting, and balancing Agent who certifies the report.

END OF SECTION
## SPECIFICATION INDEX

### DIVISION 16 – ELECTRICAL

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>16010</td>
<td>Electrical General Requirements</td>
</tr>
<tr>
<td>16050</td>
<td>Basic Electrical Materials and Methods</td>
</tr>
<tr>
<td>16110</td>
<td>Raceways, Boxes and Fittings</td>
</tr>
<tr>
<td>16111</td>
<td>Conduit</td>
</tr>
<tr>
<td>16112</td>
<td>Surface Raceways</td>
</tr>
<tr>
<td>16120</td>
<td>Wires and Cables</td>
</tr>
<tr>
<td>16140</td>
<td>Wiring Devices</td>
</tr>
<tr>
<td>16160</td>
<td>Cabinets and Enclosures</td>
</tr>
<tr>
<td>16170</td>
<td>Grounding and Bonding</td>
</tr>
<tr>
<td>16180</td>
<td>Supporting Devices</td>
</tr>
<tr>
<td>16190</td>
<td>Electrical Identification</td>
</tr>
<tr>
<td>16208</td>
<td>Packaged Engine Generator Systems</td>
</tr>
<tr>
<td>16425</td>
<td>Switchboards</td>
</tr>
<tr>
<td>16470</td>
<td>Panelboards</td>
</tr>
<tr>
<td>16477</td>
<td>Fuses</td>
</tr>
<tr>
<td>16485</td>
<td>Enclosed Contactors</td>
</tr>
<tr>
<td>16496</td>
<td>Automatic Transfer Switch</td>
</tr>
<tr>
<td>16510</td>
<td>Interior Lighting</td>
</tr>
<tr>
<td>16560</td>
<td>Exterior Lighting</td>
</tr>
<tr>
<td>16700</td>
<td>Technology General Requirements</td>
</tr>
<tr>
<td>16936</td>
<td>Modular Dimming Control -Lutron</td>
</tr>
<tr>
<td>16943</td>
<td>Network Lighting controls - Lutron Quantum</td>
</tr>
<tr>
<td>260936</td>
<td>Modular Dimming Controls-Lutron</td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Grounding and bonding.
   2. Anchors and fasteners.
   4. Identification.

1.2 DESCRIPTION

A. Grounding and Bonding: Include components and installation required to comply with NFPA 70 and meet regulatory requirements.
   1. Ground electrical service by connecting service equipment to the following grounding electrodes:
      a. Driven ground rod.
      b. Metal underground water service.
   2. OR
      a. Metal frame of building.
   3. OR
      a. Second driven ground rod.
   4. Bond electrical distribution and utilization equipment using separate, insulated equipment grounding conductor within each feeder and branch circuit raceway, including surface metal raceways.
   5. Bond personal computer outlets to main service ground with separate, isolated equipment grounding conductor.

B. Anchors and Fasteners: Anchor and fasten equipment and supports to building surfaces and elements using the following products:
   1. Concrete Structural Elements: Expansion anchors.
   2. Steel Structural Elements: Beam clamps.
   3. Concrete Surfaces: Self drilling anchors, shot fasteners, and expansion anchors.
   4. Hollow Masonry, Plaster, and Gypsum Board: Toggle bolts or hollow wall fasteners.
   5. Solid Masonry: Expansion anchors.

C. Supports: Mount equipment on stable supports:
   1. Floor supported Equipment: Housekeeping pads.
   2. Wall supported Equipment: Auxiliary support members, bolted or welded, where required for rigidity and support.
   3. Elevated Equipment: Where supported from but elevated above floors and platforms, use auxiliary support members, bolted or welded.
   4. Suspended Equipment: Use hanger rods and auxiliary support members, bolted or welded.

D. Identification: Include components required to comply with NFPA 70 and meet regulatory requirements for identifying electrical equipment, circuit elements, and connected loads.
   2. Distribution Assemblies and Large Utilization Equipment: Nameplates with 1/4-inch high

1.3 DESIGN REQUIREMENTS
   A. Determine requirements and size components in compliance with NFPA 70 as necessary to complete electrical installations.

1.4 QUALITY ASSURANCE
   A. Regulatory Requirements: Project is located in a Zone II-B seismic area.

1.5 SUBMITTALS
   A. Test Reports.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING MATERIALS
   A. Rod Electrodes: Copper, 3/4 inch diameter, 10 feet long, minimum.
   B. Mechanical Connectors: Bronze.

2.2 ANCHORS AND FASTENERS
   A. Select materials, sizes, and types of anchors and fasteners to carry loads of equipment and raceway with wire.
   B. Select finishes to obtain appropriate corrosion resistance considering the environment.

2.3 SUPPORTS
   A. Steel Channel: Galvanized steel.
   B. Auxiliary Steel Members: Comply with Section 05500.

2.4 IDENTIFICATION MATERIALS
   A. Nameplates: Engraved 3 layer micarta
      1. White letters on black background.
      2. White letters on red background for identifying emergency equipment.

PART 3 - EXECUTION

3.1 REMOVAL AND REPAIR
   A. Remove existing abandoned grounding and bonding components.
   B. Inspect existing grounding and bonding installations that remain active to ensure proper connections are in place. Tighten and repair loose or damaged connections. Measure ground resistance in compliance with NETA ATS, Section 7.13 before reusing existing system grounding electrode.
   C. Remove existing supports and anchors for abandoned electrical equipment.
D. Inspect existing supports and anchors for electrical equipment that remains active to ensure proper anchorages are in place. Tighten and repair loose or damaged supports.

E. Inspect existing nameplates for electrical equipment and utilization equipment that remains active to ensure it is secure and imprinted with proper legend. Replace loose, damaged, or incorrect nameplates.

3.2 INSTALLATION

A. Comply with NECA Standard of Installation.

B. Grounding and Bonding:
   1. Install ground rods where indicated, after completion of backfill and compaction.
   2. Terminate equipment grounding conductors at each box and equipment connection point with suitable lug, bus, or bushing.
   3. Terminate isolated grounding conductors only on terminals insulated from enclosures.

C. Anchors and Fasteners:
   1. Install surface-mounted equipment with a minimum of 4 anchors.
   2. Anchor and fasten support member by attaching flange to structure or building surface.
   3. Where inserts are not available to fasten suspended supports, drill through concrete slab from below and provide through-bolt with square steel plate and nut recessed into and grouted flush with top of slab.
   4. Bridge sheet metal studs with sheet metal channel above and below equipment fastened to hollow partitions.
   5. Do not fasten supports to pipe, duct, equipment, or raceways.
   6. Do not use spring steel clips and clamps.
   7. Do not use powder actuated anchors.
   8. Do not drill, cut, or weld to structural members.

D. Supports:
   1. Fabricate supports from structural steel or steel channel. Rigidly weld members or use bolts with spring lock washers to provide adequate strength and rigidity.
   2. Stand enclosures 1 inch off wall with steel channel supports in wet or damp locations, including utility chases.
   3. Construct housekeeping pads in compliance with Section 03300, minimum 4 inch thick and extending 6 inches beyond supported equipment.

E. Identification:
   1. Degrease and clean surfaces before applying nameplates.
   2. Install nameplates parallel to equipment lines.
   3. Secure nameplate to clearly visible location on front of equipment using screws or rivets.

3.3 FIELD QUALITY CONTROL

A. Inspect and test grounding electrodes to ensure proper installation.
   1. Comply with NETA ATS, except Section 4.
   2. Follow procedures for inspections and tests listed in Section 7.13.
   3. Obtain ground resistance of 5 ohms, maximum, by providing at least 2 additional ground rods if required.

END OF SECTION
SECTION 16110
RACEWAYS, BOXES AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION
A. Work Included:
   1. Raceways.
   2. Boxes.
   3. Fittings.

1.2 RELATED WORK:
A. Section 16010: General Electrical Requirements.
B. The Conditions of the Contract (General, Supplementary and other conditions) and the General Requirements (Division 1) are hereby made a part of this section.

1.3 SUBMITTALS
A. Submit shop drawings in accordance with Section 16010.
B. Submit material list and catalog cuts for devices and materials.
C. Submit catalog information for seismic support system.

PART 2 - PRODUCTS

2.1 GENERAL
A. Raceways, boxes and fittings shall comply with Section R16010.

2.2 RIGID STEEL CONDUIT AND FITTINGS
A. Material:
   1. Rigid Steel Conduit and Fittings: ANSI C80.1 and UL-6, hot dipped galvanized after threading.

B. Fittings:
   1. Locknuts: Steel or malleable iron.
   2. Bushings: Threaded type, malleable iron, with 105°C rated plastic insulated throat. Plastic bushings with a temperature rating of 105°C may be used for conduits 1-inch and smaller. Provide grounding type bushings where required per Section 16170.
   3. Box Connectors for Damp and Wet Locations: Provide watertight threaded hubs consisting of sealing fitting with tapered conduit thread, neoprene O-ring, and 105°C rated insulating throat with grounding and bonding lug.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS
A. Material: Steel, hot-dipped galvanized inside and out conforming to ANSI C80.3 and UL-797.
B. Couplings: Zinc plated steel, gland compression and set screw type.
C. Box Connectors: Zinc plated steel, gland compression and setscrew type with 105°C rated insulated throat.

2.4 RIGID NONMETALLIC CONDUIT (PVC) AND FITTINGS
A. Material: Polyvinyl chloride (PVC), 90°C rise rating, conforming to NEMA TC-2 type EC-40 and UL-651.
B. Conduit, Excluding Elbows: Schedule 40.
C. Elbows:
   1. Conduit 3 inches and larger: Schedule 80.
   2. Conduit smaller than 3 inches: Schedule 40 or 80 in accordance with Conduit Usage Schedule.
D. Couplings, adapters, bell ends, expansion couplings, elbows and turns of 30°: Factory made to NEMA standards TC-2 and TC-3.
E. Joint Cement: As recommended by manufacturer as suitable for the climate, furnished with instructions to achieve watertight joints.

2.5 PVC COATED CONDUIT AND FITTINGS
A. Provide rigid steel conduit and fittings with an exterior .040-inch minimum thickness PVC coating. Coat conduit interior and threads with clear urethane. Provide Occidental, Robroy Plasti-Bond Red or equivalent.

2.6 FLEXIBLE CONDUIT AND FITTINGS
A. Material: Aluminum conforming to Federal Specification WW-C-566C.
B. Fittings: Conform to ANSI C33.92, UL-listed for grounding, steel or malleable iron, zinc plated, squeeze or double grip saddle connector, 105°C insulated throat, grounding and bonding lugs.

2.7 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS
A. Conduit: Single strip steel, hot dipped galvanized prior to conduit fabrication with overall PVC jacket. Conform to UL-360.
B. Fittings: Hot-dip or mechanically galvanized with insulated throat, locknut and sealing ring.

2.8 CONDUIT ELBOWS - GENERAL
A. Provide elbows with the minimum radius required per the NEC.

2.9 CONDUIT BODIES
A. Provide threaded - hub cast ferrous or aluminum boxes. Provide with open type neoprene gaskets and matching cast ferrous covers, secured with at least two captive Type 304 stainless steel screws.

2.10 WIREWAYS
A. General: Provide electrical wireways of types, sizes, and number of channels as indicated. Fittings and accessories, including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, hangers, and end caps shall match and mate with wireway for complete system. Where features are not indicated, select to fulfill wiring requirements, plus 25% spares, and comply with provisions of NEC. Construct wireways in accordance with UL 870 and without knockouts.

B. Indoor Locations: Provide wireways with hinged covers. Provide Square D Class 5100 or equivalent.

C. Outdoor Locations: Provide raintight trough wireway complete with cover. Provide Square D Class 5130 or equivalent.

2.11 OUTLET BOXES

A. Concealed, Flush-Mounted, and dry location exposed Boxes:
1. Galvanized steel, of gang sizes and as required by code. Do not use sectional boxes for multi-gang applications.
2. Device Boxes: Minimum 4 X 4 X 1-1/2 inches with:
   a. Plaster ring for plaster and drywall construction.
   b. Square cornered tile type rings for exposed masonry wall construction and where tile is used. For masonry walls provide deep boxes or extensions such that conduits enter boxes without cutting inside surface of concrete blocks or bricks.
   c. Square corner tile type covers with ribs or extensions for casting in concrete.
   d. Permanent barriers between 227 volt switches.

B. Exposed Boxes in wet locations:
1. Cast iron or aluminum, with threaded hubs and mounting lugs.
2. Conduit bodies may be used instead of boxes except where boxes contain devices.

2.12 JUNCTION AND PULL BOXES

A. General: Construct of 12 gage steel for boxes larger than 30 by 30 inches and 14 gage for smaller boxes. Provide factory made standard sizes and shop fabricate when non-standard size boxes are shown. Comply with UL and NEMA standards. Use where conduit bodies are not practical.

B. Interior, Exposed Dry Locations: NEMA 1 pull boxes hot-dipped galvanized after fabrication in accordance with ASTM 123 or NEMA 1 pull boxes of steel fabrication, prime coated and finished with two coats of rust-resistant paint. Provide ANSI 61 grey color paint.

C. Outdoor and wet locations or where indicated as weatherproof. Where located outdoors, in wet locations, or indicated as weatherproof and where threaded-hub cast boxes and fittings are not practical, provide pull boxes constructed of code-gauge steel, prime coated, and finish with two coats of rust-resistant paint. Color shall match surrounding decor. Provide NEMA 4 construction with neoprene gaskets. Provide NEMA 3R construction.

2.13 SUPPORTING DEVICES

A. Channel:
1. Steel Channel: Steel channel 1-5/8 inches wide by 1-5/8 inches or 3-1/4 inches high by 12-gage metal thickness conforming to ASTM A570, Grade 33. Hot-dip galvanize channels after fabrication per ASTM A123. Provide fittings and two piece U shaped conduit clamps formed from ASTM A570 Grade 33 Steel and hot-dipped galvanized after fabrication in accordance with ASTM 123. Provide Unistrut P1000HG for 1-5/8 inch channel, Unistrut P1001HG for 3-1/4 inch channels or equivalent.
B. Anchor Bolts and Screws:
   1. Materials:
      b. Outdoor, Wet or Corrosive Areas: Anchor bolts and screws shall be Type 316 ASTM A276 stainless steel. Nuts shall be hex Type 316 stainless steel, ASTM A194, Grade 8M, or ASTM F594, Type 316 stainless steel.
   2. Types:
      a. Concrete: Wedge, sleeve, or self-drilling expansion anchor bolts.
      b. Solid Masonry: Sleeve expansion anchor bolts.
      c. Hollow Masonry: Toggle bolts.
      d. Wood: Lag bolts.

C. Threaded Rods:

D. Conduit Clamps:
   1. Conduit runs on concrete, masonry or wood in non-corrosive areas: One hole galvanized malleable iron clamps with galvanized malleable iron pipe spaces (clamp backs).
   2. Supports at structural steel members: Type 304 stainless-steel beam clamps at exterior, damp and corrosive areas and electrogalvanized steel beam clamps in remaining areas.
   3. Conduit Runs in Metal Stud Walls: Steel fasteners, Caddy MF clips, Minerallac stud clips or equivalent.

2.14 CONDUIT FLASHING

A. Conduits passing through roof which cannot be routed within equipment curbs shall be flashed with seamless flashing assemblies. Provide flashings with conical steel reinforced boots, eight inch skirts, interchangeable bushing, and open top cast iron counterflashings. Seal flashing neck and the conduit with Parmaseal waterproofing compound and secure protecting counterflashing to the conduit with vandal proof set screws. Seal the upper annular space between the conduit and the counterflashing with a waterproof epoxy compound. Provide Stoneman VERA-FLASH for single conduits, and Stoneman MULTI-FLASH for multiple conduits.

2.15 FIREPROOFING

A. Conduit penetrations through fire rated floors and walls: Provide materials classified by UL to provide fire stopping equal to time rating of construction being penetrated. Provide 3M, Dow Corning, International Protective Coating Products or equivalent.

B. Outlet box Firestopping Pads: Provide 7 mil square pads UL listed for two hour rating. Provide International Protection Coatings Corporation, Flame-Safe FSP1077 pads or equivalent.

2.16 OTHER PRODUCTS

A. MC cable is not allowed.

B. Electrical non-metallic tubing (ENT) is not allowed.

PART 3 - EXECUTION

3.1 CONDUIT USAGE SCHEDULE
A. General: Install the following types of conduits and fittings in locations listed, unless otherwise noted in the drawings.

B. Exterior, Exposed or subject to physical damage:
   1. Material: Rigid steel conduit.

C. Interior, Exposed and subject to physical damage:
   1. Material: Rigid steel conduit.

D. Interior, concealed, dry locations; typical for spaces above suspended ceilings, concealed in interior stud and masonry partitions:
   1. Material: Electrical metallic tubing or rigid steel conduit.

E. Interior embedded in masonry walls:
   1. Material: Rigid steel conduit.

F. Embedded in Concrete:
   1. Material: Rigid galvanized steel conduit or rigid non-metallic conduit.

G. Final connections to motors, transformers, vibrating equipment or instruments (pressure switches, valve limit switches etc.)
   2. Length: Minimum three feet conduit lengths for conduits 3 inches or larger. Minimum two feet for remaining conduit sizes. Maximum six foot length.

H. Connections to Recessed Lighting Fixtures:
   1. Material: Flexible conduit.

3.2 CONDUIT INSTALLATION, GENERAL

A. Conduit runs are shown schematically. Install concealed in finished areas and areas with T-Bar ceilings. Supports, pull boxes, junction boxes, and other ancillary equipment are not usually shown. Provide pull boxes and junction boxes where shown.

B. Run exposed conduits parallel and perpendicular to surface or exposed structural members and follow surface contours as much as practical to provide a neat appearance.

C. Make bends and offsets so that the inside diameter of conduit is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

D. Cap all conduits immediately after installation to prevent entrance of foreign matter.

E. Do not use diagonal runs except for concealed areas or when specifically shown in the drawings.

F. Route exposed conduit to preserve headroom, access space, and work space. Install with a minimum 10 feet mounting height. Install a maximum of 3 feet away from the ceiling in exposed areas.

G. Treat threaded joints of rigid steel conduit with T&B "Kopr-Shield" before installing fittings where conduit is in slabs, damp or corrosive areas.

H. Conduit Terminations:
   1. Install conduits squarely to the box when terminating with locknuts and provide one locknut outside the box and one locknut and bushing inside the box. Install locknuts
with dished side against the box. When terminating in threaded hubs, screw the conduit or fitting tight into the hub so that the end bears against the fire protection shoulder.

2. When chase nipples are used, install the raceway and coupling square to the box and tighten the chase nipple leaving no exposed threads.

I. Do not route conduits below or within concrete footing except to cross footing at 90 degree angles.

J. Install exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel.

K. Provide expansion fittings for raceways crossing expansion joints in structures and in straight runs exceeding 100 feet.

L. The distance between pull boxes shall not exceed 150 feet.

3.3 GROUNDING

A. Provide grounding in accordance with Section 16170.

B. Use grounding bushings for conduits carrying a bonding conductor.

C. Provide a grounding conductor in flexible and liquidtight flexible conduit, size conforming to NEC Article 250 -Equipment Grounding Conductors.

3.4 SUPPORTS

A. Above Suspended Ceiling and at Structural Steel Members: Support conduit on or from the structure. Install conduits as close to the structure as possible.

B. Conduit on Concrete, Masonry or Wood: Conduit clamps with pipe spacers (clamps backs). Grouped conduits may be supported with channel. Anchor with anchor bolts.

C. Suspended Conduit: Split-hinged pipe rings with threaded rods sized for the weight to be carried. For grouped conduits, construct trapeze type racks with threaded rods and channel. Construct channel to limit deflection to 1/200 of span. Clamp each conduit individually to a channel members. Where rods are more than 12 inches long, provide seismic support.

1. Construct trapeze type supports so two conduits may be added in the future. Future conduit size will be equivalent to the largest conduit on the support being constructed.

D. Maximum Spacing of Raceway Supports:
### Raceway Size (inches) | No. of Conductors in Run | Location | Support Spacing (feet) | RSC | EMT
--- | --- | --- | --- | --- | ---
### Horizontal Runs

<table>
<thead>
<tr>
<th>Raceway Size</th>
<th>No. of Conductors in Run</th>
<th>Location</th>
<th>Support Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2, 3/4</td>
<td>1 or 2</td>
<td>Flat ceiling or wall</td>
<td>5</td>
</tr>
<tr>
<td>1/2, 3/4</td>
<td>1 or 2</td>
<td>Where it is difficult to provide supports except at intervals fixed by the building construction</td>
<td>7</td>
</tr>
<tr>
<td>1/2, 3/4</td>
<td>3 or more</td>
<td>Any location</td>
<td>7</td>
</tr>
<tr>
<td>1 &amp; larger</td>
<td>1 or 2</td>
<td>Flat ceiling or wall</td>
<td>6</td>
</tr>
<tr>
<td>1 &amp; larger</td>
<td>1 or 2</td>
<td>Where it is difficult to provide supports except at intervals fixed by the building construction</td>
<td>10</td>
</tr>
<tr>
<td>1 &amp; larger</td>
<td>3 or more</td>
<td>Any locations</td>
<td>10</td>
</tr>
<tr>
<td>Any</td>
<td>....</td>
<td>Concealed</td>
<td>10</td>
</tr>
</tbody>
</table>

### Vertical Runs

<table>
<thead>
<tr>
<th>Raceway Size</th>
<th>No. of Conductors in Run</th>
<th>Location</th>
<th>Support Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2, 3/4</td>
<td>....</td>
<td>Exposed</td>
<td>7</td>
</tr>
<tr>
<td>1, 1-1/4</td>
<td>....</td>
<td>Exposed</td>
<td>8</td>
</tr>
<tr>
<td>1-1/2 and larger</td>
<td>....</td>
<td>Exposed</td>
<td>10</td>
</tr>
</tbody>
</table>

### 3.5 Conduit Penetrations

A. Unless otherwise indicated, dry-pack with nonshrinking grout around raceways that penetrate concrete block, masonry and concrete walls, floors or ceilings.

B. Maintain the integrity of all damp-proofing and water proofing membranes that are penetrated by raceways and boxes.

C. Nonshrinking grout shall conform to the Corps of Engineers specification for Nonshrinking Grout, CRD-621-88 and to these specifications. Use a non-gas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency.

D. Gypsum Board Wall Penetrations: Provide circular penetrations maximum 1/8-inch larger in diameter than outer diameter of conduit being used. On both sides of the wall fill space between conduit and wall with joint compound, depth to match gypsum board thickness.

### 3.6 Damaged Conduits

A. Repair or replace conduit damaged during or after installation.

B. Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.
C. Repair cuts, nicks or abrasions in the zinc coating of galvanized conduit with galvanizing repair stick, Enterprise Galvanizing "Galvabra" or equivalent.

D. Repair cuts, nicks or abrasions in the PVC coating of the conduit with the manufactures recommended PVC material and build up surface thickness to match the factory coating thickness and color.

3.7 EMPTY CONDUITS

A. Provide 200-pound strength, 1/8 inch diameter braided yellow polypropylene pull cord in empty conduits.

B. Provide a waterproof label on each end of the pull cords to indicate the destination of the other end.

3.8 OUTLETS FOR GENERAL WIRING

A. Use multi-gang boxes and device plates where several devices are located in the same general area. Obtain back box requirements for systems provided under other sections and provide them per those requirements.

B. Mount outlets for different conduit systems shown in the same wall areas not more than 5 inches on center.

C. Locate switch boxes 4 inches from door jamb. Verify rough-in dimensions for outlets occurring above counters, cabinets, mirrors, etc. to ensure that finished outlet clears all trim.

D. Rigidly support boxes for wall and ceiling outlets and finish flush and straight. Front edge shall be within 1/8-inch of finished surface and plumb. In stud walls use rigid bar hangers, attached to hanger with stud and nut. In ceilings attach to building structure. Anchor boxes into masonry construction with one or more integral flanges.

E. No outlets shall be back-to-back. In non-fire rated walls, place outlets so that adjacent boxes facing opposite sides are isolated by a stud.

F. Outlets in Fire Rated Walls: Separate outlets on opposite sides of fire rated walls a minimum distance of 24 inches. Cover back of outlet with firestopping pads.

3.9 WARNING TAPES

A. Bury warning tapes approximately 12 inches below grade, above all underground conduits and duct banks. Align parallel to and within 3 inches of the centerline of the conduit or duct bank.

B. Plastic tape shall be yellow, 3 inch minimum width. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape. Manufacturers and types: ITT Blackburn Type YT, Griffolyn Co., Terra-Tape, or equivalent.

3.10 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways and boxes, inspect interiors of raceways and boxes; clear all blockages and remove burrs, dirt and construction debris.

END OF SECTION
SECTION 16111
CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal conduit.
B. Flexible metal conduit.
C. Liquidtight flexible metal conduit.
D. Electrical metallic tubing.
E. Nonmetal conduit.
F. Fittings and conduit bodies.

1.2 RELATED SECTIONS

A. Section 07840 - Firestopping.
B. Section 16130 - Boxes.
C. Section 16170 - Grounding and Bonding.
D. Section 16190 - Supporting Devices.
E. Section 16195 - Electrical Identification.

1.3 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
E. NECA "Standard of Installation."
F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
G. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.
1.5 SUBMITTALS  
A. Submit under provisions of Section 01330.

1.6 PROJECT RECORD DOCUMENTS  
A. Submit under provisions of Section 01781.  
B. Accurately record actual routing of conduits larger than 2 inches (51 mm).

1.7 REGULATORY REQUIREMENTS  
A. Conform to requirements of ANSI/NFPA 70.  
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING  
A. Deliver, store, protect, and handle Products to site under provisions of Section 01600.  
B. Accept conduit on site. Inspect for damage.  
C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.  
D. Protect PVC conduit from sunlight.

1.9 PROJECT CONDITIONS  
A. Verify that field measurements are as shown on Drawings.  
B. Verify routing and termination locations of conduit prior to rough-in.  
C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS  
A. Minimum Size: 3/4 inch (19 mm) unless otherwise specified.  
B. Outdoor Locations, Above Grade: Use rigid steel or intermediate metal conduit.  
C. Wet and Damp Locations: Use rigid steel conduit, intermediate metal conduit, electrical metallic tubing.  
D. Dry Locations:  
   1. Concealed: Use rigid steel conduit, intermediate metal conduit, electrical metallic tubing or, thick wall nonmetallic conduit.  
   2. Exposed: In unoccupied areas use rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.

2.2 METAL CONDUIT
A. Rigid Steel Conduit: ANSI C80.1.
B. Intermediate Metal Conduit (IMC): Rigid steel.
C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; all steel fittings.

2.3 FLEXIBLE METAL CONDUIT
A. Description: Interlocked steel construction.

2.4 LIQUIDtight FLEXIBLE METAL CONDUIT
A. Description: Interlocked steel construction with PVC jacket.

2.5 ELECTRICAL METALLIC TUBING (EMT)
A. Description: ANSI C80.3; galvanized tubing.
B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression type.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install conduit in accordance with NECA "Standard of Installation."
B. Install nonmetallic conduit in accordance with manufacturer's instructions.
C. Arrange supports to prevent misalignment during wiring installation.
D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
F. Fasten conduit supports to building structure and surfaces under provisions of Section 16190.
G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
H. Do not attach conduit to ceiling support wires.
I. Arrange conduit to maintain headroom and present neat appearance.
J. Route exposed conduit parallel and perpendicular to walls.
K. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
L. Route conduit in and under slab from point-to-point.
M. Do not cross conduits in slab.

N. Maintain adequate clearance between conduit and piping.

O. Maintain 12 inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

P. Cut conduit square using saw or pipecutter; de-burr cut ends.

Q. Bring conduit to shoulder of fittings; fasten securely.

R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

S. Install no more than equivalent of three, (two for data (communications), 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.

T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.

V. Provide suitable pull string in each empty conduit except sleeves and nipples.

W. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

X. Ground and bond conduit under provisions of Section 16170.

Y. Identify conduit under provisions of Section 16195.

Z. Conceal raceways within building finished surfaces unless otherwise indicated.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Section 07840.

B. Exterior wall penetrations shall be made weathertight.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Surface metal raceways.
B. Multi-outlet assemblies.

1.2 RELATED SECTIONS
A. Section 16141 - Wiring Devices: Receptacles.

1.3 REFERENCES
A. NECA (National Electrical Contractor's Association) Standard of Installation.
B. NEMA WD 6 - Wiring Device Configurations.

1.4 SUBMITTALS
A. Submit under provisions of Section 01330 – Submittal Procedures.
B. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 QUALITY ASSURANCE
A. Perform Work in accordance with NECA "Standard of Installation".
B. Maintain one copy of document on site.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAY

A. Manufacturers:
   1. Wiremold, Model 4000, 500, 700 Series
   2. MonoSystems, SMS 4200 Series
   3. Substitutions: Under provisions of Section 01630

B. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

C. Size: As shown on Drawings.

D. Finish: Ivory, or to match existing being extended.

E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories.

2.2 MULTIOUTLET ASSEMBLY

A. Manufacturers:
   1. Wiremold, Model V4000 Series.

B. Multioutlet Assembly: Sheet metal channel with fitted cover, suitable for use as multioutlet assembly.

C. Size: 4.75 x 1.75 inch.

D. Receptacles: Provide covers and accessories to accept receptacles specified in Section 16141. Each receptacle shown to have a Two-Gang duplex cover, for a 20A receptacle in bottom half and a duplex style communication device in top half. Installation shall have snap on cover equal to Wiremold V4048B or V4048BF.

E. Receptacle Spacing: As indicated.

F. Receptacle Color: Ivory.

G. Channel Finish: Ivory Scuffcoat®.

H. Fittings: Furnish manufacturer's standard couplings, elbows, outlet and device boxes, wire clips, divider clips, connectors, and field cutting tools. Do not field fabricate fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.

D. Wireway Supports: Provide steel channel as specified in Section 16190.

E. Close ends of wireway and unused conduit openings.

F. Ground and bond raceway and wireway under provisions of Section 16170.

G. Use factory supplied tools for cutting of base and covers. Use Wiremold catalog number 640B for base cuts, Wiremold catalog number 640C for cover cuts, Wiremold catalog number 605 for V500 raceway cuts, and Wiremold catalog number 607 for V700 raceway cuts. Do not use saw cuts for field cutting.

H. Extend 2 compartment wireways to ceiling. Terminate above ceiling with conduit adapter.

I. Use Wiremold V500 or V700 for extensions to individual power outlets only. All other connections and routing shall be with V4000 series.

J. Install wireway with top of wireway 22” above finish floor, or as directed by architect. Counter height mounting shall be above splash back (42” to bottom of wireway) or as directed by architect.

K. In all occupied areas: All wiring shall be concealed unless otherwise noted or prevented by existing construction materials. For exposed wiring, provide specified surface raceway, per Part 2, sized for the number of conductors utilized or as noted on drawings, for all systems, including, but not limited to, power, lighting, data, phone, ITV, clock, intercom, security, and fire alarm systems.

END OF SECTION
SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Wires and cables, 600 volts and less.

1.2 RELATED WORK:

A. The Conditions of the Contract (General, Supplementary and other conditions) and the General Requirements (Division 1) are hereby made a part of this section.

B. Section 16010: General Electrical Requirements.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with Sections 01330 and 16010.

B. Submit catalog cuts and material list for each conductor type. Indicate insulation material, conductor material, voltage rating, manufacturer and other data pertinent to the specific cable, such as type shielding, number of pairs and applicable standards.

C. Submit catalog cuts for devices.

PART 2 - PRODUCTS

2.1 GENERAL

A. Wires and cables shall comply with section 16010.

2.2 POWER WIRE

A. Conductor material: Class B stranded, soft annealed copper per ASTM B-3.


C. Minimum conductor size: #12 AWG.

2.3 CONTROL WIRE

A. Conductor: Class C stranded soft annealed copper per ASTM B-3.


C. Minimum Conductor Size: #14 AWG.

2.4 CONDUCTOR CONNECTOR/SPLICES

B. Aboveground Dry and Damp Locations, #8 AWG and Larger:
   1. Use one piece, standard length barrel, copper compression splice. Provide Thomas and Betts two way connectors, Burndy "Hylink", Teledyne "Penn-Union Penn Crimps" or equal.

C. In-ground Handholes and Pull Boxes, #10 AWG and smaller: As specified above plus sealing with individual sealing packs of Scotchcast 400 Resin or equal.

D. See Section R16170: GROUNDING for connectors used with specialized grounding applications.

2.5 MOTOR TERMINATIONS
   A. Splice conductors to motor leads with copper compression terminal lugs bolted together and insulated with an EPDM rubber slip-on lug cover. Provide 3M Electrical Products 1000V or less Non-Shielded Cable Motorlead Splicing Kits or equal.

2.6 PULLING COMPOUND
   A. Use only cable pulling compound which is approved by the manufacturer of the cable as being compatible with cable insulation and jacket materials.

2.7 CONDUCTOR TAGS
   A. Provide plastic sleeve markers, Thomas and Betts, SM markers; Panduit Clip-On markers, Brady SCD clip sleeve markers or equal.

2.8 ELECTRICAL TAPE/SHRINKABLE INSULATORS
   A. Vinyl Tape: 7 mil, 600 volt rated, flame retardant, hot and cold weather resistant vinyl tape conforming to UL 510. Provide 3M Super 33+ Scotch vinyl tape or equal.

   B. Vinyl Tape for Color Coding: 7 mil, 3/4" wide, hot and cold weather resistant vinyl tape conforming to UL 510. Provide 3M 35 Scotch vinyl tape or equal.

   C. Vinyl Mastic: 90 or 125 mil self-fusing, rubber based insulating vinyl mastic laminated to PVC. Provide 3M 2200 or 2210 or equal.

   D. Rubber Tape: EPR rubber, 90 degrees C continuous rated. Provide 3M 130C Scotch Tape or equal.

   E. Shrinkable Insulators: Provide heat or cold shrinkable insulator tubing. Provide Thomas and Belts "Shrink-Kon" heatshrink insulators, 3M thick wall heat shrinkable cable sleeves, 3M 8420 series cold shrink cable sleeves or equal.

2.9 OTHER PRODUCTS
   A. The use of BX, MC and AC cable is not permitted.

PART 3 - EXECUTION

3.1 WIRE INSTALLATION
   A. Install wiring and cable in conduit unless otherwise noted.
B. To reduce pulling tension in long runs, coat cables with pulling compound.

C. Remove debris and moisture from the conduits, boxes and cabinets prior to cable installation.

D. Group conductors in panelboards, motor control centers, cabinets, pull boxes and switchboard wireways; tie with plastic ties; and fan out to terminals.

E. Terminate phase conductors A, B and C reading left to right or top to bottom looking into the front of the equipment.

F. Install control wire between devices without splices.

3.2 IDENTIFICATION

A. Color Coding of Power Wire: Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Volts</th>
<th>Volts</th>
<th>Volts</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Orange</td>
</tr>
<tr>
<td>Phase C</td>
<td>---</td>
<td>Blue</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
<td>White</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

B. Conductors #10 AWG and smaller shall have factory color coding with solid color insulation.

C. Conductors #8 AWG and larger shall have factory color coding with solid color insulation or shall have black insulation with on-site application of colored tape at conductor terminations and at splices.

D. Control wires shall have colored insulation. Provide separate color codes for each wire in conduit that has up to seven wires. Conduits with more than seven wires shall have at least seven types of colored insulation.

E. Tagging of Conductors: Tag control wires and instrument cable in panels, pullboxes, handholes, wireways and at control devices. Tag control wires and instrument cables with same wire numbers as on the shop drawings submittals or drawings. Tag power wires in pullboxes, handholes and wireways where there is more than one circuit with motor control center or panelboard number and circuit numbers. In panelboards, tag conductors with circuit numbers one inch from termination at circuit breaker.

3.3 WIRE SPLICING AND CONNECTING

A. Tighten electrical connections and terminals, including screws and bolts, in accordance with manufacturers published torque tightening values. Where manufacturer’s torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

B. Retighten bolt-type connectors 24 to 48 hours after initial installation and before taping.

C. Insulate splices with either tape or with shrinkable insulators.

1. Tape connections as follows: Step 1- Apply one layer of varnish and cambrie tape; Step 2- apply vinyl mastic for air/moisture seal; Step 3 - apply one layer of rubber tape half lapped; Step 4 - apply two layers of half lapped vinyl tape.
D. At switchboards, terminate conductors with copper conductor compression lugs.

3.4 INSULATION RESISTANCE TESTS (CIRCUITS BELOW 600 VOLTS)

A. Perform insulation resistance test for each feeder and motor circuit prior to energizing. Applied potential to be 1,000 volts DC for 1 minute. Insulation resistance between conductors and between each conductor and ground shall not be less than 2 megohms. Repair or replace wires or cables in circuits that do not pass this test and repeat the test.

END OF SECTION
SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall switches.
B. Receptacles.
C. Wall plates.

1.2 RELATED SECTIONS

A. Section 16130 - Boxes.

1.3 REFERENCES

A. NECA - "Standard of Installation".
B. NEMA WD 1 - General Requirements for Wiring Devices.
C. NEMA WD 6 - Wiring Device Configurations.

1.4 SUBMITTALS FOR REVIEW

A. Refer to Section 01330 – Submittals Procedures submittals requirements.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
C. Manufacturer's Instructions:
   1. Indicate application conditions and limitations of use stipulated by products testing agency specified under Regulatory Requirements.
   2. Include instructions for storage, handling, protection, examination, preparation, operation, and installation of Product.
   3. Submit manufacturer's installation instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years documented experience.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.7 EXTRA MATERIALS

A. Section 01770 - Closeout Procedures.
B. Furnish two of each style, size, and finish wall plate.

C. Provide two protective rings.

D. Provide two carpet rings.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:
   1. Leviton.
   2. Pass & Seymour.
   3. Hubbell.
   4. Substitutions: Refer to Section 01630 – Product Substitutions.

B. Description: NEMA WD 1, heavy-duty, AC only general-use snap switch.

C. Device Body: Ivory nylon with toggle handle.

D. Voltage Rating: 120-277 volts, AC.

E. Current Rating: 20 amperes.

F. Ratings: Match branch circuit and load characteristics.

2.2 RECEPTACLES

A. Manufacturers:
   1. Leviton.
   2. Pass & Seymour.
   3. Hubbell.
   4. Substitutions: Refer to Section 01630 – Product Substitutions.

B. Description: NEMA WD 1; heavy-duty specification grade side and back wired.

C. Device Body: Ivory nylon.

D. Configuration: NEMA WD 6; type as specified and indicated.

E. Convenience Receptacles: Type 5-20.

F. GFCI Receptacle: 20 Ampere specification grade convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

G. Isolated Ground Receptacle: Type 5-20; Device body - Orange nylon.

2.3 WALL PLATES

A. Wall plates shall be smooth high abuse nylon. Finish shall match the finish of devices.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Refer to Section 01310 – Project Management and Coordination: Verification of existing conditions prior to beginning work.

B. Verify that outlet boxes are installed at proper height.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes before installing devices.

3.3 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Install in accordance with NECA "Standard of Installation".

C. Install devices plumb and level.

D. Install receptacles with grounding pole on bottom.

E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

G. Connect wiring devices by wrapping conductor around screw terminal.

H. Use jumbo size plates for outlets installed in masonry walls.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceiling, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights specified and indicated on drawings.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 18 inches above finished floor.

D. Install convenience receptacle 6 inches above counter.

E. Install telephone jack 18 inches above finished floor.

F. Install telephone jack for side-reach wall telephone to position top of telephone of 54 inches (1.4 m) above finished floor.

G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.
3.5 FIELD QUALITY CONTROL
A. Section 01400 - Quality Requirements: Field inspection, testing, adjusting, and balancing.
B. Inspect each wiring device for defects.
C. Operate each wall switch with circuit energized and verify proper operation.
D. Verify that each receptacle device is energized.
E. Test each receptacle device for proper polarity.
F. Test each GFCI receptacle device for proper operation.
G. Verify that each telephone jack is properly connected and circuit is operational.

3.6 ADJUSTING
A. Section 01770 - Closeout Procedures: Adjusting installed work.
B. Adjust devices and wall plates to be flush and level.

3.7 CLEANING
A. Section 01770 - Closeout Procedures: Cleaning installed work.
B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hinged cover enclosures.
B. Cabinets.
C. Terminal blocks.
D. Accessories.

1.2 REFERENCES

A. Section 01400 - Quality Requirements:
B. Section 01420 - References: Requirements for references and standards and Statutory Requirements.
C. NECA Standard of Installation (National Electrical Contractors Association).
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
E. NEMA ECS 4 - Terminal Blocks for Industrial Control Equipment and Systems.

1.3 SUBMITTALS FOR REVIEW

A. Section 01330 – Submittals Procedures: for submittal requirements.
B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Products: Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 EXTRA (MAINTENANCE) MATERIALS

A. Section 01782 - Operation and Maintenance Data.
B. Furnish two of each cabinet key. All cabinets installed in this project shall be keyed alike.
PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Hoffman.
B. Substitutions: Refer to Section 01630 – Product Substitutions.

2.2 HINGED COVER ENCLOSURES
A. Construction: NEMA 250, Type 1 steel enclosure.
B. Covers: Continuous hinge, held closed by flush latch operable by key.
C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
D. Enclosure Finish: Manufacturer’s standard enamel.

2.3 CABINETS
A. Boxes: Galvanized steel.
B. Box Size: As indicated on drawings.
C. Backboard: Provide 3/4 inch thick plywood backboard for mounting terminal blocks. Paint with fire resistant matte white.
D. Fronts: Steel, surface type with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
E. Knockouts: As required.
F. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
G. Provide accessory feet for free-standing equipment.

2.4 TERMINAL BLOCKS
A. Manufacturers:
   1. Siemon.
C. Power Terminals: Use construction type with closed back and tubular pressure screw connectors, rated 600 volts.
D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
E. Provide ground bus terminal block, with each connector bonded to enclosure.

2.5 ACCESSORIES
A. Plastic Raceway:
1. Panduit.
2. Description: PVC wiring duct.
3. Substitutions: Refer to Section 01630.
4. Description: Plastic channel with hinged or snap-on cover.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify conditions under provisions of Section 01310.
   B. Verify that surfaces are ready to receive Work.

3.2 INSTALLATION
   A. Section 01400 - Quality Requirements: Manufacturer's instructions.
   B. Install in accordance with NECA "Standard of Installation".
   C. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
   D. Install cabinet fronts plumb.

3.3 CLEANING
   A. Refer to Section 01770 - Closeout Procedures: Cleaning installed work.
   B. Clean electrical parts to remove conductive and harmful materials.
   C. Remove dirt and debris from enclosure.
   D. Clean finishes and touch up damage.

END OF SECTION
SECTION 16170
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding electrodes and conductors.
B. Equipment grounding conductors.
C. Bonding.

1.2 RELATED SECTIONS

A. Section 03300 - Cast-In-Place Concrete.

1.3 REFERENCES

B. NFPA 70 - National Electrical Code.

1.4 GROUNDING SYSTEM DESCRIPTION

A. Existing Metal underground water pipe.
B. Metal frame of the building.
C. Concrete-encased electrode.
D. Rod electrode.
E. Plate electrode.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms or less.

1.6 SUBMITTALS FOR INFORMATION

A. Section 01330 – Submittals Procedures, for submittal requirements.
B. Test Reports: Indicate overall resistance to ground and resistance of each electrode. Indicate reference ground used in test.
C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 SUBMITTALS FOR CLOSEOUT

A. Section 01770 - Closeout Procedures:
B. Section 01782 - Operation and Maintenance Data.

C. Project Record Documents: Record actual locations of components and grounding electrodes.

D. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

1.9 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

A. Material: Copper clad steel.

B. Diameter: 3/4 inch (19 mm).

C. Length: 10 feet (3000 mm).

2.2 MECHANICAL CONNECTORS

A. Material: Bronze.

2.3 EXOTHERMIC CONNECTIONS

A. Manufacturers:
   1. Cadweld.

2.4 WIRE

A. Material: Stranded copper.

B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

EXAMINATION

A. Section 01310 – Project Management and Coordination: Verification of existing conditions prior to beginning work.

B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION
A. Section 01400 - Quality Requirements: Manufacturer's instructions.

B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

C. Provide bonding to meet Regulatory Requirements.

D. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION
SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and equipment supports.
B. Anchors and fasteners.

1.2 REFERENCES

A. NECA - National Electrical Contractors Association.

1.3 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures for submittal requirements.

A. Product Data: Provide manufacturer's catalog data for fastening systems.
B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance.
B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
C. Anchors and Fasteners:
   1. Concrete Structural Elements: Use expansion anchors.
   2. Steel Structural Elements: Use beam clamps.
   5. Solid Masonry Walls: Use expansion anchors.

2.2 STEEL CHANNEL
A. Manufacturer:
   1. B-Line.
   2. Thomas & Betts.

B. Description: Galvanized steel or factory paint.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, steel deck, or conduit.

D. Do not use spring steel clips and clamps.

E. Do not use powder-actuated anchors.

F. Do not drill or cut structural members.

G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts. Use galvanized components in wet and damp locations.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations use galvanized steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.

J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION
SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and labels.
B. Wire and cable markers.
C. Conduit markers.
D. Underground Warning Tape.

1.2 RELATED SECTIONS

A. Section 09900 – Painting and Coatings.
B. Section 16700 - Technology General Requirements.

1.3 REFERENCES


1.4 SUBMITTALS

A. Submit under provisions of Section 01330 – Submittal Procedures.
B. Product Data: Provide catalog data for nameplates, labels, and markers.
C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer micarta, white letters on black background. For emergency equipment, white letters on red background.

B. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Communication 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.

### 2.2 WIRE MARKERS

A. **Manufacturers:**
   1. Brady.

B. **Description:** Cloth, tape, split sleeve, or tubing type wire markers.

C. **Locations:** Each conductor at panelboard gutters, outlet and junction boxes, and each load connection.

D. **Legend:**
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on shop drawings.

### 2.3 CONDUIT MARKERS

A. Use colored tape or coordinate color of paint (1" minimum band) with Section 09900 – Painting and Coatings to identify conduit by system.
   5. Motor and Other Control Systems - Orange/Blue.
   6. Telephone System - Black.
   8. Category-5 Cable - Light Green
   9. Fiber Optics Cable - Dark Green

### 2.4 UNDERGROUND WARNING TAPE

A. **Description:** 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

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**PART 3 - EXECUTION**

#### 3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

#### 3.2 APPLICATION

A. Install nameplates and labels parallel to equipment lines.

B. Secure nameplates to equipment front using screws and rivets.

C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

D. Identify underground conduits using underground warning tape. Install one tape per trench at 3
inches below finished grade.

E. Install framed color code for conduit identification in all electrical rooms.

F. Install colored conduit paint band within 6" of each J-box 50' centers above ceilings and where conduits pass through walls.

G. Identify conduit using field painting under provisions of Section 09900.

END OF SECTION
SECTION 16208
PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator system.
B. Engine-mounted radiator.
C. Heat exchanger.
D. Exhaust silencer and fittings.
E. Fuel fittings and day tank.
F. Remote control panel.
G. Battery and charger.
H. Weatherproof enclosure.

1.2 RELATED SECTIONS

A. Section 15240 - Vibration Isolation and Seismic Control.
B. Section 15410 - Plumbing Piping: Fuel system piping.
C. Section 15890 - Ductwork.
D. Section 15910 - Ductwork Accessories.
E. Section 16496 - Enclosed Transfer Switch.

1.3 REFERENCES

B. ANSI/NEMA MG 1 - Motors and Generators.

1.4 SYSTEM DESCRIPTION

A. Engine generator system to provide source of emergency and standby power.
B. System Capacity: 350 kW, 438 kVA @ 0.8pf, at elevation of 2,500 feet above sea level, and ambient temperature and 120 degrees F; standby rating using engine-mounted radiator.

1.5 SUBMITTALS
A. Submit shop drawings and product data under provisions of Section 01330 – Submittal Procedures.

B. Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.

C. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and engine mounted radiator.

D. Submit manufacturer's installation instructions.

1.6 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 01781.

B. Accurately record location of engine generator and mechanical and electrical connections.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01782.

B. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in packaged engine generator system with minimum three years documented experience.

B. Supplier: Authorized distributor of engine generator manufacturer with service facilities within 50 miles of project site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 01600.

B. Store and protect products under provisions of Section 01600.

C. Accept packaged engine generator set and accessories on site in crates and verify damage.

D. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.10 WARRANTY

A. Provide five-year warranty under provisions of Section 01770.

1.11 MAINTENANCE SERVICE

A. Furnish service and maintenance of packaged engine generator system for one year from Date of Substantial Completion.

1.12 EXTRA MATERIALS
A. Submit maintenance materials under provisions of Section 01701. Manufacturer to provide one-year maintenance agreement.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. Kohler.

B. Detroit Diesel.

C. Generac.

D. Onan.

E. Caterpillar

F. Substitutions: Under provisions of Section 01630 – Product Substitutions.

**2.2 ENGINE**

A. Type: Water-cooled inline or V-type, four stroke cycle, internal combustion engine.

B. Rating: Sufficient to operate at 10 percent overload for one hour at specified elevation and ambient limits.

C. Fuel System: Appropriate for use of No. 2 fuel oil.

D. Engine Speed: 1800 rpm.

E. Governor: Isochronous type to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer’s instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C), and suitable for operation on 120 volts AC.

I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F (43 degrees C). Radiator Air Flow Restriction: 0.5 inches of water (9.34 mm of mercury), maximum.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gage, water temperature gage, and lube oil pressure gage on engine-generator control panel.

K. Mounting: Provide unit with integral vibration isolation between generator and skid or suitable spring type vibration isolators mounted on structural steel base.
2.3 GENERATOR

A. Generator: ANSI/NEMA MG 1; three phase, four pole, reconnectible brushless synchronous generator with brushless exciter.

B. Rating: 350 kW, 438 kVA, at 0.8 power factor, 480Y/277 volts, 60 Hz at 1800 rpm.

C. Insulation: ANSI/NEMA MG 1, Class F.

D. Temperature Rise: 130 degrees C standby.

E. Enclosure: ANSI/NEMA MG 1; open drip proof.

F. Voltage Regulation: Include generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics, with voltage regulation +/- one percent from no load to full load. Include manual controls to adjust voltage drop +/- 5 percent voltage level, and voltage gain.

2.4 ACCESSORIES

A. Day Tank: 693-gallon double wall skid base fuel tank. Include flexible fuel line connections, fuel gage, check valve, low fuel level alarm contact, and indicating light.

B. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.

C. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, 170 ampere-hours minimum capacity. Match battery voltage to starting system. Include necessary cables and clamps.

D. Battery Tray: Plastic coated metal or wooden tray treated for electrolyte resistance, constructed to contain spillage of electrolyte.

E. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet ANSI/NEMA 250, Type 1 requirements.

F. Line Circuit Breaker: NEMA AB 1 molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole; number and rating as indicated. Mount unit in enclosure to meet ANSI/NEMA 250, Type 1 requirements.

G. Engine-Generator Control Panel: ANSI/NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
   1. Frequency Meter: 45-65 Hz range, 3-1/2 inch (89 mm) dial.
   2. AC Output Voltmeter: 3-1/2 inch (89 mm) dial, 2 percent accuracy, with phase selector switch.
   3. AC Output Ammeter: 3-1/2 inch (89 mm) dial, 2 percent accuracy, with phase selector switch.
   4. Output voltage adjustment.
   5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
   7. Engine running time meter.
   8. Oil pressure gage.
10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.


H. Provide an alarm annunciator panel for remote mounting with the following status LEDs and audible signals:

<table>
<thead>
<tr>
<th>LAMP LEGEND</th>
<th>LIGHT</th>
<th>AUDIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM Sensor Loss</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Overcrank</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Overspeed</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Oil Pressure</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>High Water Temperature</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Water Level</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Emergency Stop</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Not In Auto</td>
<td>Red</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-Low Oil Pressure</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-High Water Temperature</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-Low Water Temperature</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>Pre-Low Fuel</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery Charger AC Failure</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>Low Battery Voltage</td>
<td>Yellow</td>
<td>Yes</td>
</tr>
<tr>
<td>High Battery Voltage</td>
<td>Yellow</td>
<td>No</td>
</tr>
<tr>
<td>Generator Run</td>
<td>Yellow</td>
<td>No</td>
</tr>
<tr>
<td>Generator Power</td>
<td>Yellow</td>
<td>No</td>
</tr>
<tr>
<td>System Ready</td>
<td>Green</td>
<td>Yes</td>
</tr>
<tr>
<td>Communications OK</td>
<td>Green</td>
<td>Yes</td>
</tr>
<tr>
<td>Line Power</td>
<td>Green</td>
<td>No</td>
</tr>
<tr>
<td>Spare</td>
<td>Green</td>
<td>No</td>
</tr>
</tbody>
</table>

1. The panel shall have a RE-ARM HORN switch that, when pressed, will silence the audible alarm. A TEST switch must be included to verify the lights are functional and a RESET switch to reset any condition after it has cleared. The remote annunciator shall have provision for programming a switch with the capability of starting and stopping the standby generator set from the annunciator panel. Digital communication with the generator system shall be via 2-wire RS485 serial data link.

I. Enclosure: Provide with NEMA 37 weatherproof enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work and field dimensions are as shown on Drawings.

B. Verify that required utilities are available in proper location and ready for use.

C. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL
A. Field inspection and testing will be performed under provisions of Section 01400.

B. Provide full load test utilizing portable test bank, if required, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.

C. During test, record the following at 20-minute intervals:
   1. Kilowatts.
   2. Amperes.
   3. Voltage.
   4. Coolant temperature.
   5. Room temperature.
   6. Frequency.
   7. Oil pressure.

D. Test alarm and shutdown circuits by simulating conditions.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare, start, test, and adjust systems under provisions of Section 01700.

3.5 ADJUSTING

A. Adjust work under provisions of Section 01700.

B. Adjust generator output voltage and engine speed.

3.6 CLEANING

A. Clean work under provisions of Section 01700.

B. Clean engine and generator surfaces. Replace oil and fuel filters

3.7 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01820.

B. Describe loads connected to emergency and standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency and standby power.

END OF SECTION
SECTION 16425
SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Switchboards.
B. Switchboard accessories.

1.2 RELATED SECTIONS
A. Section 03300 - Cast-in-Place Concrete: Concrete for supporting foundations and pads.
B. Section 16170 - Grounding and Bonding.
C. Section 16477 - Fuses.

1.3 REFERENCES
A. ANSI C12 - Code for Electricity Metering.
B. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments.
C. ANSI C57.13 - Requirements for Instrument Transformers.
D. NEMA AB 1 - Molded Case Circuit Breakers.
E. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
F. NEMA PB 2 - Dead Front Distribution Switchboards.
G. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
H. NEMA 260 - Safety Labels for Padmounted Switchgear and Transformers Sited in Public Areas.
J. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS
A. Section 01330 – Submittals Procedures: for submittals requirements.
B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.
D. Test Reports: Indicate results of factory production tests.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.5 SUBMITTALS FOR CLOSEOUT

A. Section 01770 – Closeout Procedures:

B. Section 01782 - Operation and Maintenance Data: Submittals for project closeout.

C. Record actual locations of switchboard in project record documents.

D. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 – Product Requirements: Transport, handle, store, and protect products.

B. Deliver in 48 inch (1219 mm) maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on approved shop drawings.

1.10 MAINTENANCE MATERIALS

A. Section 01770 – Closeout Procedures.

B. Furnish two of each key.

PART 2 - PRODUCTS
A. MANUFACTURERS

B. Square-D.

C. General Electric.

D. Eaton/Cutler-Hammer.


2.2 SWITCHBOARD

A. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

B. Ratings:
   1. Voltage: As indicated on drawings.
   2. Configuration: As indicated on drawings.
   3. Main Bus: As indicated on drawings.
   4. Integrated Equipment Rating: As indicated on drawings.

C. Main Section Devices: Individually mounted.

D. Distribution Section Devices: Individually mounted.

E. Auxiliary Section Devices: Individually mounted.

F. Bus Material: Copper, standard size.

G. Bus Connections: Bolted, accessible from front for maintenance.

H. Ground Bus: Extend length of switchboard.

I. Molded Case Circuit Breakers: NEMA AB 1, integral thermal and instantaneous magnetic trip in each pole.
   1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
   2. Include shunt trip, where indicated.

J. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated. Torque all line and load connections as specified by manufacturer.

K. Metering Transformer Compartment: For Utility Company's use; compartment size, bus spacing and drilling, door, and locking and sealing in accordance with Utility Company's requirements.

L. Pull Section: Size as shown on Drawings. Arrange as shown on Drawings with pull section on left side of switchboard as viewed from the front.


N. Enclosure: Type NEMA-1, Indoor.
1. Align sections at front and rear.
2. Switchboard Height: 90 inches excluding floor sills, lifting members and pull boxes.
3. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide concrete housekeeping pad under the provisions of Section 03300. Pad shall be 4" high and extend 2" in each direction beyond footprint of floor mounted equipment.

3.2 INSTALLATION

A. Install switchboard in locations shown on Drawings, according to NEMA PB 2.1.
B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

3.3 FIELD QUALITY CONTROL

A. Section 01455 – Starting of Systems: Field inspection, testing, and adjusting.
B. Inspect and test in accordance with NETA ATS, except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.4 ADJUSTING

A. Section 01455 – Testing, Adjusting, and Balancing: Adjusting installed work.
B. Adjust all operating mechanisms for free mechanical movement.
C. Tighten bolted bus connections in accordance with manufacturer's instructions.
D. Adjust circuit breaker trip and time delay settings to values as instructed by Architect/Engineer.

3.5 CLEANING

A. Section 01770 – Closeout Procedures: Cleaning installed work.
B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Distribution panelboards.

B. Branch circuit panelboards.

C. Load centers.

1.2 RELATED WORK

A. Section 16170 - Grounding and Bonding.

B. Section 16190 - Supporting Devices.

C. Section 16195 - Electrical Identification: Engraved nameplates.

D. Section 16477 - Fuses.

1.3 REFERENCES

A. NECA (National Electrical Contractors Association) "Standard of Installation".

B. NEMA AB 1 - Molded Case Circuit Breakers.

C. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

D. NEMA KS 1 - Enclosed Switches.

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.


H. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 01330 – Submittals Procedures: for submittal requirements.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.5 Submit manufacturer’s installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
1.6 SUBMITTALS FOR CLOSEOUT
A. Section 01770 - Closeout Procedures:
B. Section 01782 - Operation and Maintenance Data: Submittals for project closeout.
C. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
D. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE
A. Perform work in accordance with NECA “Standard of Installation”.
B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS
A. Conform to requirements of NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.10 FIELD MEASUREMENTS
A. Verify that field measurements are as indicated on shop drawings.

1.11 MAINTENANCE MATERIALS
A. Section 01770 - Closeout Procedures.
B. Provide maintenance materials under provisions of Section 01750.
C. Provide two of each panelboard key. All panelboards shall be keyed alike.

PART 2 - PRODUCTS
2.1 DISTRIBUTION PANELBOARDS
A. Section 01600 – Product Requirements: Product Options.
B. Manufacturers:
1. Square D.
3. GE.
   a. Challenger equipment is not acceptable.
C. Description: NEMA PB 1, circuit breaker type. Provide combination controllers as indicated.

D. Service Conditions:
   1. Temperature: 120 degrees F (40 degrees C).
   2. Altitude: 2,500 feet.

E. Panelboard Bus: Copper ratings as indicated. Provide 200% where indicated.

F. Minimum short circuit rating: 14,000 amperes rms symmetrical for 240 volt panelboards; 25,000 amperes rms symmetrical for 480 volt panelboard, or as indicated.

G. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: designed to accommodate Class R fuses.

H. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

I. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

J. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

K. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay. Coil operating voltage: 120 volts, 60 Hertz. Size as shown on drawings. Provide unit mounted control power transformer and HAND-OFF-AUTO selector switch, and RED indicating light in front cover.

L. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

M. Enclosure: NEMA PB 1, Type as indicated or required by installation conditions.

N. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Section 01600 – Product Requirements: Products Options.

B. Manufacturers:
   1. Square D.
   2. Eaton/Cutler-Hammer
   3. GE.

C. Description: NEMA PB 1, circuit breaker type, lighting and appliance branch circuit panelboard.

D. Panelboard Bus: Copper rating as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled; provide 200% neutral bus where indicated.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt
panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards, or as indicated.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, type as indicated or as required by installation conditions.

H. Cabinet Box: 6 inches (153 mm) deep, 20 inches (508 mm) wide for 240 volt and less panelboards, 20 inches (508 mm) wide for 480 volt panelboards.

I. Cabinet Front: Flush or surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer’s standard gray enamel.

J. Provide a hard-wired secondary surge arrester in each data power panel. Surge arrester shall be Square D, Catalog #SDSA 3650, or equal.

2.3 LOAD CENTERS

A. Section 01600 – Product Requirements: Products Options.

B. Manufacturers:
   1. Square D.
   2. Eaton/Cutler-Hammer
   3. GE.

C. Description: Circuit breaker load center, with bus ratings as indicated.

D. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.

E. Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Class A ground fault interrupter circuit breakers where indicated. Do not use tandem breakers.

F. Enclosure: General Purpose or Rainproof as indicated or as required for installation conditions.

G. Box: Flush or surface type with door, and lock on door. Finish in manufacturer’s standard gray enamel.

2.4 FUSES

A. Fuses 600 Amperes and Less: Dual element, current limiting, time delay, one-time fuse, UL Class RK 1.

B. Fuses 601 Amperes and Larger: Current limiting, time delay fast-acting one time fuse, 600 volt, UL Class L.

C. Interrupting Rating: 200,000 rms amperes.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install panelboards in accordance with NEMA PB 1.1 and NECA "Standard of Installation".

B. Install panelboard plumb. Provide supports in accordance with Section 16190. [Install recessed panelboards flush with wall finishes].

C. Height: 6 ft. to top of panelboard; install panelboards taller than 6 ft. with bottom no more than 4 inches above floor.

D. Provide filler plates for unused spaces in panelboards.

E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

F. Provide engraved plastic nameplates under the provisions of Section 16195.

G. Provide spare conduits out of recessed panelboard to an accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch (DN27). Identify each as SPARE.

H. Ground and bond panelboard enclosure according to Section 16170.

3.2 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

D. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire circuits.

E. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness or connections for circuit breakers, fusible switches, and fuses.

3.3 ADJUSTING

A. Section 01770 - Closeout Procedures: Adjusting installed work.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 10 percent of each other. Maintain proper phasing for multi-wire circuits.

END OF SECTION
SECTION 16477
FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Fuses.
   B. Spare fuse cabinet.

1.2 RELATED SECTIONS
   A. Section 09900 – Painting and Coatings: Painting of spare fuse cabinet.

1.3 REFERENCES
   B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 SUBMITTALS
   A. Submit under provisions of Section 01330.
   B. Product Data: Provide data sheets showing electrical characteristics including time-current curves.

1.5 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Section 01781.
   B. Record actual fuse sizes.

1.6 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten (10) years documented experience.

1.7 REGULATORY REQUIREMENTS
   A. Conform to requirements of NFPA 70.
   B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.8 MAINTENANCE MATERIALS
   A. Provide maintenance materials under provisions of Section 01781.
   B. Provide two fuse pullers.

1.9 EXTRA MATERIALS
   A. Furnish under provisions of Section 01770.
B. Provide three of each size and type fuse installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bussman.
B. Gould-Shawmut.
C. Substitutions: Under provisions of Section 01630.

2.2 FUSE REQUIREMENTS

A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
C. Main Service Switches Larger than 600 amperes: Class L time delay or fast-acting, Class T as indicated.
D. Main Service Switches: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
E. Power Load Feeder Switches Larger than 600 amperes: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
F. Power Load Feeder Switches: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
G. Motor Load Feeder Switches: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
H. Lighting Load Feeder Switches Larger than 600 amperes: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
I. Lighting Load Feeder Switches: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
J. Other Feeder Switches Larger than 600 amperes: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
K. Other Feeder Switches: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
L. Power Branch Circuits: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
M. Motor Branch Circuits: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.
N. Lighting Branch Circuits: Class RK1 time delay, non-time-delay; RK5, J non-time-delay, time delay, or Class T as indicated.

2.3 CLASS RK1 (TIME DELAY) FUSES
A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.4 CLASS RK1 (NON-TIME-DELAY) FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.5 CLASS RK5 FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.6 CLASS J (TIME DELAY) FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.7 CLASS J (NON-TIME-DELAY) FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.8 CLASS T FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.9 CLASS L (FAST-ACTING) FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.10 CLASS L (TIME DELAY) FUSES

A. Manufacturers:
   1. Bussman.
   2. Gould-Shawmut.

2.11 CLASS G FUSES

A. Manufacturers:
1. Bussman.
2. Gould-Shawmut.

2.12 SPARE FUSE CABINET

A. Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.

B. Doors: Hinged, with hasp for Owner's padlock.

C. Finish: Prime finish for field painting.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in accordance with manufacturer's instructions.

B. Install fuse with label oriented such that manufacturer, type, and size are easily read.

C. Install spare fuse cabinet where indicated.

END OF SECTION
SECTION 16485
ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. General purpose contactors.
B. Lighting contactors.

1.2 REFERENCES
A. ANSI/NEMA ICS 6 – Enclosures for Industrial Controls and Systems.
B. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.

1.3 SUBMITTALS
A. Submit under provisions of Section 01330 – Submittal Procedures.
B. Product Data: Include dimensions, size, voltage ratings and current ratings.
C. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.4 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01781.
B. Accurately record actual location of each contactor and indicate circuits controlled.

1.5 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 01782.
B. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten (10) years documented experience.

1.7 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS
2.1 GENERAL PURPOSE CONTACTORS
   A. Description: NEMA ICS 2, AC general purpose magnetic contactor.
   B. Coil Voltage: As scheduled.
   C. Poles: As scheduled.
   D. Size: As scheduled.
   E. Enclosure: ANSI/NEMA ICS 6, Type as scheduled.
   F. Accessories: As scheduled.

2.2 LIGHTING CONTACTORS
   A. Description: NEMA ICS 2, magnetic lighting contactor.
   B. Configuration: Electrically held.
   C. Coil Voltage: As scheduled.
   D. Poles: As scheduled.
   E. Contact Rating: As scheduled.
   F. Enclosure: ANSI/NEMA ICS 6, as scheduled.
   G. Accessories: As scheduled.

2.3 ACCESSORIES
   A. Push Buttons and Selector Switches: NEMA ICS 2, heavy duty type.
   B. Indicating Lights: NEMA ICS 2, push-to-test type.
   C. Auxiliary Contacts: NEMA ICS 2, Class A300.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install in accordance with manufacturer's instructions.

END OF SECTION
SECTION 16496
AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Automatic transfer switch.

1.2 RELATED SECTIONS
A. Section 16195 - Electrical Identification: Engraved nameplates.

1.3 REFERENCES
A. NFPA 70 - National Electrical Code.
B. NEMA ICS 1 - General Standards for Industrial Control and Systems.
C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.4 SUBMITTALS
A. Submit under provisions of General Conditions.
B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE
A. Perform work in accordance with NECA "Standard of Installation".
B. Maintain one copy of each reference document on site.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of General Conditions.
B. Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions when engine generator is running.
C. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of General Conditions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated.

1.11 MAINTENANCE SERVICE

A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.12 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of General Conditions.

B. Provide two of each special tool required for maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Kohler.

B. Detroit Diesel Spectrum.

C. ASCO.

D. Generac.

E. Substitutions: Under provisions of General Conditions.

2.2 AUTOMATIC TRANSFER SWITCH

A. Description: NEMA ICS 2, automatic transfer switch.
B. Configuration: Electrically operated, mechanically held transfer switch.

2.3 SERVICE CONDITIONS
A. Service Conditions: NEMA ICS 1.
B. Temperature: 120 degrees F.
C. Altitude: 2,500 feet.

2.4 RATINGS
A. Voltage: 208 volts, three phase, four wire, 60 Hz.
B. Switched Poles: 3.
C. Load Inrush Rating: Combination load.
D. Continuous Rating: As shown on plans.
E. Interrupting Capacity: 100 percent of continuous rating.
F. Withstand Current Rating: 42,000 rms symmetrical amperes, when used with molded case circuit breaker, or as shown on drawings.

2.5 PRODUCT OPTIONS AND FEATURES
A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.
B. Test switch: Mount in cover of enclosure to simulate failure of normal source.
C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.
D. Transfer Switch Auxiliary Contacts: 1 normally open; 1 normally closed.
E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 80 percent or frequency varies more than 3 percent from rated nominal value.
F. Alternate Source Monitor: Monitor alternate source voltage, frequency, phase reversal and single phase condition; inhibit transfer when voltage is below 80 percent or frequency varies more than 3 percent from rated nominal value.
G. Switched Neutral: Non-Overlapping contacts.
H. Provide phase loss and reversal protection from utility source.

2.6 AUTOMATIC SEQUENCE OF OPERATION
A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
B. Time Delay To Start Alternate Source Engine Generator: 0 to 10 seconds, adjustable.
C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

D. Time Delay before Transfer to Alternate Power Source: 0 to 60 seconds, adjustable.

E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

F. Time Delay Before Transfer to Normal Power: 0 to 120 seconds, adjustable; bypass time delay in event of alternate source failure.

G. Time Delay Before Engine Shut Down: 0 to 10 minutes, adjustable, of unloaded operation. Diesel generator shall run for at least 10 minutes if it starts due to a momentary power bump.

H. Engine Exerciser: Start engine every 7 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.

I. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

2.7 ENCLOSURE

A. Enclosure: NEMA 3R.

B. Finish: Manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions under the provisions of General Conditions.

B. Verify that surface is suitable for transfer switch installation.

3.2 PREPARATION

A. Provide housekeeping pads under the provisions of Section 03100.

3.3 INSTALLATION

A. Install transfer switches in accordance with manufacturer's instructions.

B. Provide engraved plastic nameplates under the provisions of Section 16195.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of General Conditions.

3.5 DEMONSTRATION

A. Provide systems demonstration under provisions of General Conditions.

B. Demonstrate operation of transfer switch in normal, and emergency modes.

C. Demonstrate operation by simulating a loss of power situation by turning off the main supply.

D. Demonstrate operation of transfer to the alternate source upon simulation of single and
reversed phase conditions.

END OF SECTION
SECTION 16510
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires and accessories.
B. Emergency lighting units.
C. Exit signs.
D. Ballasts.
E. Lamps
F. Luminaire accessories.

1.2 RELATED SECTIONS

A. Section 16130 - Boxes.

1.3 REFERENCES

A. ANSI C78.379 – Electric Lamps – Incandescent and High – Intensity Discharge Reflector Lamps – Classification of Beam Patterns.
B. ANSI C82.1 – Ballasts for Fluorescent Lamps – Specifications.
C. ANSI C82.4 – Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
F. NEMA WD 6 – Wiring Devices – Dimensional Requirements.

1.4 SUBMITTALS

A. Submit under Section 01330 Submittal Procedures.
B. Shop Drawings: Indicate dimensions and components for each luminaire that is not standard product of the manufacturer.
C. Product Data: Provide dimensions, ratings, and performance data.
D. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
1.5 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01781.
B. Accurately record actual locations of each luminaire.

1.6 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 01782.
B. Maintenance Data: Include replacement parts list.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in the Section with minimum ten (10) years documented experience.

1.8 REGULATORY REQUIREMENTS
A. Conform to requirements of ANSI/NFPA 70.
B. Conform to requirements of NFPA 101.
C. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 LUMINAIRES
A. Furnish products as specified in schedule.
B. Substitutions: Under provisions of Section 01630.
C. Fluorescent Fixtures:
   1. Description: Static troffer type luminaire with ballast and lamps installed by luminaire manufacturer. The following fixtures have been evaluated as meeting the following specification.
      a. Lithonia 2SPG432A19120GEB
      b. Columbia 4PS4G-244-REL3532TP-120-NSC-PAF
      c. Hubbel RD4GNC03-A1E-9A
      d. Lightolier SPS2GFSVA432
      e. Williams 5224-FWTA156-6CP1/S
      f. Prudential P8624-480C-P19A-SW-X-1
      g. Metalux 2GC-432A-120V-LE3-.156 lens/NEOPRENE Gasket
      h. Daybrite SG244Q-SFSA19D
      i. Similar fixtures in the same specifications family for 2 lamp, 3 lamp, and 1 x 4 fixtures are also approved equal.
   2. Size: As scheduled.
   4. Lens and Enclosure: Prismatic acrylic lens, pattern 19. Provide gasketing between frame and luminaire housing or permanent, integral light stop to illuminate “light leak”. Foam gasketing is not acceptable.
   5. Photometric Control Elements: White coating, baked to form a smooth glossy durable
finish electrostatically applied. Minimum reflectance to be 86%.

6. Photometric Performance: Minimum coefficient of utilization 0.65 at room cavity ratio of 2 with ceiling-wall-floor reflectance of 70-50-20 percent and with A19 lens.

7. Socket Assembly: Bracket assembly shall be code gauge cold rolled steel held firmly in place without screws. Provide tombstone style pressure lock lampholders with plated contacts. Center of lamp to lenses shall be no closer than 2.7 inches. Lenses shall have a uniform.

8. Mounting: As scheduled.

9. Ballast: Per section 2.3.

10. Lamp: One, two, three, or four as noted on schedule.

11. Flush Door Frame: .045 inch extruded aluminum with mitered corners, equipped with two replaceable zinc plated T-type hinges and two replaceable cam latches. Painted white to match fixture.

12. Wireway Cover: Code gauge tension secured with hinging on one side, or captioned spring cover mounting with removable chains.

D. LED LUMINAIRES

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

<table>
<thead>
<tr>
<th>LUMINAIRE TYPE</th>
<th>MINIMUM LUMINAIRE EFFICACY (LE)</th>
<th>MINIMUM COLOR RENDERING INDEX (CRI)</th>
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<tr>
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<tr>
<td>LED Linear Ambient</td>
<td>80 LPW</td>
<td>80</td>
</tr>
</tbody>
</table>

LED luminaires must also meet the following minimum requirements:

1. Luminaires must have a minimum 10 year manufacturer’s warranty.
2. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES MS-21, with data obtained per IES LM-80 requirements.
3. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
4. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.
5. Luminaires must be listed with the DesignLights Consortium ‘Qualified Products List’ when falling into category of “General Application” luminaires, i.e. Interior Directional, Display Case, Troffer, Linear Ambient, or Low/High Bay. Requirements are shown in the DesignLights Consortium “Technical Requirements Table”.
2.2 EXIT SIGNS

A. Description: Exit sign fixture.

B. Housing: Diecast Aluminum.

C. Face: Diecast Aluminum.

D. Directional Arrows: As indicated.

E. Mounting: As indicated.

F. Lamps: LED with diffused panel (RED).

G. Input Voltage: 120/277 volts.

2.3 BALLASTS

A. Fluorescent Electronic Ballast:
   1. General electronic ballasts shall meet the requirements of UL 935 and shall bear the appropriate UL label and shall be manufactured by Advance Transformer.
   2. Submittals: Provide manufacturers’ data for each type of electronic ballast installed. Also provide nationally recognized independent test laboratory data verifying compliance with the specifications herein. Indicate actual lumen output of lamps with ballast.
   3. Warranty: The electronic ballasts shall be warranted against defects in materials and workmanship for five years.
   4. Mechanical Construction: Electronic ballasts shall have the same physical dimensions, mounting arrangements and ballast to lamp socket lead lengths as those of their core and coil counterparts.
   5. Electrical Characteristics: The electronic ballast shall withstand input power line transients as defined in ANSI C62.41. The ballast shall tolerate a line voltage Variation of +/- 10%.
   6. The power factor shall be 95% or higher. The lamp crest factor shall measure 1.7 or less.
   7. The electronic ballast shall be Class “A” sound rated and UL Class P thermally protected.
   8. Total harmonic distortion of the input current to the electronic ballast shall not exceed 10% of the input current.
   9. The electronic ballast shall comply with FCC rules and regulations, Part 18 concerning the generation of both EMI (electromagnetic interference) and RFI (radio frequency interference).
   10. The electronic ballast shall have an input wattage that does not exceed 75% of the value for their standard electromagnetic core and coil counterparts or 85% of the value for their energy efficient core and coil counterparts. Lamp lumens of the ballast system shall not be less than 87.5% of the rated lumens of the lamp.
   11. The electronic ballast shall operate the lamp at a frequency of 20 KHZ or greater to both improve lamp efficiency and reduce the effects of lamp flicker.
   12. The ballast shall start and operate standard lamps at 50 degrees F and energy savings lamps at 60 degrees F. Ballast case temperature shall not exceed 25 degrees C rise above a 40 degrees C ambient.
   13. A ballast shall be provided with an internal fuse to protect the electrical power supply from internal component failure. The ballast shall also be short circuit protected in the event of miswiring.
   14. Due to extensive use of motion sensors, only rapid start type ballasts will be considered. Do not use instant start type ballasts.
   15. Approvals: Each ballast/lamp combination will be considered separately. Blanket
approval of a manufacturer’s line of ballasts will not be given.

16. Performance Evaluation: All evaluations will be based upon independent laboratory test data. All ballasts must be approved prior to individual project bidding.

17. Provide a single ballast in all 1, 2, 3, or 4 lamp fixtures that do not have multiple switching. Provide 1 – 2 lamp and 1 – 1 lamp ballast in 3 lamp multiple switched fixtures. Provide 2 – 2 lamp ballasts in 4 lamp multiple switched fixtures. Lamps and ballasts may be tandem wired in multiple switched fixtures.

B. High Intensity Discharge (HID) Ballast:
   1. Description: Pulse start metal halide ballast equal to Venture Uni-Form pulse start system.
   2. Provide ballast suitable for lamp specified.
   3. Voltage: Match luminaire voltage.

2.4 LAMPS

A. Lamps shall be manufactured by:
   1. Osram/Sylvania
   2. General Electric
   3. Philips

B. Metal halide lamps shall be equal to Venture Uni-Form pulse start lamps.

C. Do not substitute other manufacturers.

D. T8 fluorescent lamps shall be 230 ma with an initial lumen output of 2,950 lumens, 86 CRI, and color temperature of 3500 Kelvin unless otherwise noted on the fixture schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate and supporting grids for luminaires.

B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

C. 2’ x 4’ luminaires are to be supported per one of the following methods: (See additional seismic support requirements below.)
   1. Independently of the ceiling grid with (4) #12 gauge wires from the fixture to the building structure, not the roof deck. OR
   2. By the ceiling grid with a minimum of one #12 gauge support wire from the grid within 3” of each of the four corners of the fixture.

D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
F. Install recessed luminaires to permit removal from below. Connect with flexible metal conduit from J-box in vicinity of fixture. Limit flex to 6’ maximum.

G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

H. Install clips to secure recessed grid-supported luminaires in place.

I. Install wall mounted luminaires, emergency lighting units and exit signs at height as indicated on drawings.

J. Install accessories furnished with each luminaire.

K. Connect luminaires, emergency lighting units and exit signs to branch circuit outlets provided under Section 26 05 33 as indicated.

L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Install specified lamps in each luminaire, emergency lighting unit and exit sign.

O. Do not use manufactured wiring systems.

P. In addition to other support methods, install #12 seismic support wires to luminaires as follows:
   1. 2’ x 4’ luminaire – 2 total, located at diagonal corners.
   2. Recessed cans – 1 total
   3. Motion/smoke detectors – none required.

Q. Seismic support wires may be slack under normal conditions but shall not allow more than 6” deflection of the fixture if the ceiling is eliminated.

R. Ceiling mounted motion sensors and smoke detectors shall be fed with a short flexible whip and supported by a 24” bracket bar hanger clipped to T-bar ceiling.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Adjust work under provisions of Section 01700.

B. Aim and adjust luminaires as indicated on drawings.

C. Adjust exit sign directional arrows as indicated.

D. Relamp luminaires that have failed lamps prior to Substantial Completion.

3.5 CLEANING

A. Clean work under provisions of Section 01700.

B. Clean electrical parts to remove conductive and deleterious materials.
3.6 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01650.

B. Provide minimum of two hours demonstration of luminaire operation.

END OF SECTION
SECTION 16560
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Exterior luminaires with lamps and ballasts.
   2. Luminaire-mounted photoelectric relays.

B. See Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.2 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.

B. Shop Drawings: Include anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. 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. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.


N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Low-Temperature Ballast Capability: Rated by its manufacturer for reliable starting and operation of indicated lamp(s) at temperatures 0 deg F(minus 18 deg C) and higher.

B. Ballast Characteristics:
   1. Power Factor: 90 percent, minimum.
   2. Sound Rating: A.
   3. Total Harmonic Distortion Rating: Less than 10 percent.
   6. Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures 0 deg F(minus 18 deg C) and higher.

D. Fluorescent Lamps: Low-mercury type. Comply with the EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
2.4 LED LUMINAIRES

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

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LED luminaires must also meet the following minimum requirements:

A. Luminaires must have a minimum 10 year manufacturer’s warranty.
B. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES MS-21, with data obtained per IES LM-80 requirements.
C. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
D. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.
E. Luminaires must be listed with the DesignLights Consortium ‘Qualified Products List’ when falling into category of “General Application” luminaires, i.e. Interior Directional, Display Case, Troffer, Linear Ambient, or Low/High Bay. Requirements are shown in the DesignLights Consortium “Technical Requirements Table”.
F. Provide Department of Energy “Lighting Facts” label for each luminaire.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.
B. Fasten luminaire to indicated structural supports.
   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
C. Adjust luminaires that require field adjustment or aiming.
3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-(0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

END OF SECTION
SECTION 16700
TECHNOLOGY GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. INCLUSIONS
1. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1 and 2, General Requirements, are included as a part of this section as though bound herein.

1.2 RELATED SECTIONS

A. The requirements of this Section supplement Section 01010 and shall apply to Work for Sections listed under Division 16700 - Technology General Requirements.

B. Section 07840 – Firestopping.

C. Section 01630 – Product Substitutions.

1.3 PERFORMANCE

A. Provide the labor, materials, equipment, appliances, services and transportation, and perform the operations in connection with the construction and installation of the Work. Work shall be as herein specified and as denoted on the accompanying Drawings.

1.4 INTERPRETATION OF CONTRACT DOCUMENTS

A. PRECEDENCE
1. Precedence of project documents shall be as follows:
   a. If any discrepancy in the specifications or drawings exists: The most stringent or highest quantity version has precedence.
   b. Resolve all discrepancies by written direction from the architect.

B. OMISSIONS
1. The omission of express reference to any parts necessary for, or reasonably incidental to, a complete installation shall not be construed as a release from providing such parts.

C. ANCILLARY AND ACCESSORY ITEMS
1. No exclusion from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the accessories necessary to complete any required system or item of equipment are to be omitted.

D. DRAWINGS
1. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed in accordance with the intent diagrammatically expressed on the drawings and described in these specifications. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.

1.5 REFERENCE MATERIALS AND/OR CODES

A. ORDINANCES
1. All work shall conform to all federal, state, and local ordinances and building official requirements.

B. UNLV STANDARDS
   1. All installation methods, materials, installation and testing shall meet the requirements of the "UNLV Campus Wiring Specification dated August 26, 2015", which shall take precedence over this specification section.

C. BUILDING CODES
   1. All work shall conform to all state and local building codes and the following:
      3. National Fire Protection Association (NFPA)

D. UL LISTING
   1. All material and equipment shall be listed, labeled, or certified by Underwriter’s Laboratories, Inc. Where such standards have been established.

E. FCC APPROVAL
   1. The system shall be approved for direct interconnection to the utility services under Part 68 of FCC rules and regulations.
   2. Those systems, which are not FCC approved or utilize an intermediary device for connection, will not be considered. Provide FCC registration number of system being proposed with submittals.

1.6 QUALITY ASSURANCE

A. GENERAL
   1. All equipment and materials required for installation under these specifications shall be new (less than 1 year from date of manufacture) and without blemish or defect.

B. SPECIFIC
   1. Each major component of equipment shall have the manufacturer’s name, address, model number, and rating on a plate securely affixed in a conspicuous place.
   2. NEMA code ratings, UL label, or other data which is die-stamped on the surface of the equipment shall be in an easily visible location.

1.7 ACCEPTABLE MANUFACTURERS

A. These specifications are based on equipment produced by or for specific manufacturers.

B. It is not the intent of these specifications to limit or restrict submission of proposals for products by other manufacturers, but to set a baseline of operational functions and equipment standards. The contractor may submit proposals for the use of products by other manufacturers where product designation includes, "or equal".

C. The owner’s representative will provide the final judgement regarding the products listed by the apparent low bidder in their material list submittal. See section 01630 for product substitution procedures.

1.8 INSTALLING CONTRACTOR QUALIFICATIONS

A. Installing contractor must have a minimum of three years previous experience in RF distribution systems, and/or data communications, and/or telecommunication systems. Installing contractor for the fiber optic cable and terminations must have two years previous experience. Upon request of the owner’s representative, the contractor and/or vendors supplying all or part of the work described herein shall supply project references, which substantiate the contractor/ vendors’ previous experience as noted herein.
B. The installing contractor must be a qualified technology contractor.

C. All work on this project must be performed by full-time regular employees of the successful, qualified technology contractor. In the event a sub-contractor is used/required for any part of the project, the sub-contractor shall also be a qualified technology contractor.

PART 2 - PRODUCT STANDARDS

2.1 DEVICE LOCATIONS

A. Locate all apparatus requiring adjustments, cleaning, or similar attention so it will be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.

2.2 SUPPORTS

A. Provide and install brackets, braces, and supports as required. Minimum fastening and/or support safety factor shall be at least three (3). Design shall be to the approval of the Owner.

2.3 PAINTING

A. All supporting structures and enclosures supplied by the contractor not having a standard factory paint finish shall be painted in a manner approved by the owner.

2.4 PAINT COLOR

A. Provide, as may be required, custom color and/or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be submitted to the Architect for approval.

B. This does exclude equipment or materials where standard colors and finishes are specified herein, unless otherwise noted.

2.5 BLANK AND CUSTOM PANELS

A. Finish of blank panels and/or custom assembly panels utilized for termination and/or interconnection as part of this system shall be stainless steel.

B. In addition, provide blank plastic panels finished in matte (or satin) black to close off all spaces around the source equipment in the distribution room racks. These panels shall have cutouts, which provide access to the source machine and its controls. Match each panel to the device it is covering in the racks. Submit a sample of the plastic with finish to the Architect for approval.

2.6 MARKINGS

A. Switches, connectors, jacks, receptacles, outlets, cables and cable terminations shall be logically and permanently marked in a manner approved by the Owner. Custom panel nomenclature shall be engraved, etched, or screened. Marking for these items are purposely detailed in the drawings to ensure consistency and clarity. Verify any changes in working type size, and/or placement with the owner prior to marking. Mount on the custom rack panels as described above a designation of each source machine, which correlates to the system architecture. Submit a sample layout for Architect approval.

2.7 ENVIRONMENT

A. The equipment specified herein is designed to operate in environments of normal humidity, dust,
and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.

2.8 REFERENCE STANDARDS

A. The standard references for the layout and construction of the system shall be:

1. GENERAL
   a. UNLV Campus Wiring Specification dated August 26, 2015.
   b. TIA/EIA-568- Commercial Building Standard for Telecommunications Wiring
   c. TIA/EIA-569- Commercial Building Standard for Telecommunications Pathways and
   d. Spaces.
   e. TIA/EIA-606- Administrative Standard for the Telecommunications Infrastructure of
   f. Commercial Buildings.
   g. TIA/EIA-607-Commercial Building Grounding/Bonding Requirements.
   h. BICSI-TDM-Manuals-Building Industry Consulting Service International-
   j. ANSI- American National Standards Institute
   k. UL Listed- Underwriter’s Laboratories Listed
   l. UL Certified- Underwriter’s Laboratories LAN Cable Certification Program.
   m. NEMA- National Electrical Manufacture’s Association.

2. AUDIO
   a. Handbook for Sound Engineers
   b. The New Audio Cyclopedia
   c. (Howard W. Sams, Indianapolis, Indiana 1987)
   d. Davis Sound System Engineering Second Edition
   e. (Howard W. Sams, Indianapolis, Indiana 1987)

3. VIDEO
   a. National Association of Broadcasters Engineers Handbook

4. FIBER OPTICS
   a. Refer to the fiber optic cable manufacturers design guide: i.e. SIECOR
   b. Siecor Universal Transport System (UTS)
   d. Brochure #CC-110
   e. Also refer to the following standards committees:
      1) ANSI: Proposed Fiber Distributed Data Interface (FDDI) Physical Media Documents
      2) Institute of Electrical & Electronic Engineers (IEEE) 802.8
      3) Electronic Industries Association (EIA) Committees:
      4) TR4 1.8.1: Working Group on Commercial & Industrial Building Wiring Standard
      5) FO-6: Fiber Optic Committee
      6) FO-6.7: Fiber Optic Cable Sub Committee
      7) FO-2: Fiber Optic Systems Committee
      8) nsulated Cable Engineers Association Inc. (ICEA)
      9) WG 596: Fiber Optic Premises Distribution Cable
      10) American Society for Testing Materials (ASTM):
      11) DO9.18, TG-12: Task Group on Fiber Optics

PART 3 - EXECUTION

3.1 GENERAL

A. Perform this work in accordance with acknowledged industry and professional standards and practices, existing building conditions, and as specified herein. Provide and install all materials,
devices, components, and equipment for complete, operational systems.

B. Maintain a competent supervisor and supporting technical personnel, acceptable to the Architect, during the entire installation. Change of the supervisor during the project shall not be acceptable without prior written approval from the Owner and the Architect.

C. Coordinate all efforts with those of related trades. In the event of any conflicts, delayed or improper preparatory work by others, notify the Architect. The Architect’s decision will be binding. Verify all field conditions.

3.2 CONDUIT

A. The Educational Technology Systems (ETS) contractor shall be responsible for reviewing the completed conduit and raceway installation for the ETS as provided by the project’s electrical contractor. If the completed installation does not conform to the following sections (3.02, 3.03, and 3.04) AND the ETS contractor believes such conditions may cause system problems, notify the Architect of those deviations.

1. INSTALLATION
   a. Where installed exposed in electrical closets, conduits shall be parallel with or at right angles to walls or ceilings and shall be adequately supported from walls or ceilings by means of approved galvanized iron clamps or hangers.
   b. Conduits stubbed above ceiling line shall have a bushing for cable protection and be turned in toward the room which will be serviced by the cables pulled into that conduit/box.
   c. Penetration of a vertical firewall shall use a 4-inch square box with a single gang ring.
   d. Only raceway, which is specifically designed for surface mounting (WIREMOLD V4000 or equivalent), shall be mounted on the surface of walls. No conduit normally installed in the interior of walls shall be acceptable for surface mount applications.

2. CONDUIT SIZE
   a. Minimum size conduit shall be ¾ inch. All conduit to be sized for maximum 40% fill or less.

3. CONDUIT SEPARATION
   a. THESE GROUPS MUST NEVER BE INTERMIXED IN A GIVEN CONDUIT!
   b. Low Voltage Systems wiring is divided into wiring groups according to their nominal voltage levels and cable types. Those groups are:
      1) GROUP A - Extremely sensitive wiring (0 to 100mv).
      2) GROUP B - Moderately sensitive wiring (100mv to 10v).
      3) GROUP C - Non sensitive wiring (10v to 70v)
      4) GROUP D - AC Power Wiring
      5) GROUP E - Fiber Optic cables.
   c. Intra-System Separation
      1) Minimum conduit separation between conduits carrying wiring of different groups is as follows (90 degree crossings in close proximity are acceptable):

<table>
<thead>
<tr>
<th>GROUP</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>adjacent</td>
<td>6”</td>
<td>12”</td>
<td>12”</td>
<td>adjacent</td>
</tr>
<tr>
<td>B</td>
<td>adjacent</td>
<td>6”</td>
<td>6”</td>
<td>adjacent</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>adjacent</td>
<td>6”</td>
<td>adjacent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>adjacent</td>
<td>adjacent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>adjacent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d. Electrical Service Separation
   1) Minimum conduit separation between conduits carrying wiring of
different groups, as defined above, and other electrical service conduit is as follows: (All fiber optic conduit, Group E, may be adjacent to other electrical service conduit).

<table>
<thead>
<tr>
<th>OTHER SERVICES</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimmer Controlled Lighting</td>
<td>24&quot;</td>
<td>12&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>220/440V circuits</td>
<td>12&quot;</td>
<td>6&quot;</td>
<td>6&quot;</td>
</tr>
</tbody>
</table>
| All other services SCR (controlled or switched) | 24"| 12"| 6"

3.3 ELECTRICAL POWER

A. GROUNDING
   1. Review and coordinate electrical power system installation including grounding, with the electrical contractor to ensure proper operation of the system.

B. VERIFICATION
   1. Verify that all AC power circuits designated for the system are properly wired, phased, and grounded. Report in writing any discrepancies found to the Owner for corrective action.

3.4 EQUIPMENT RACKS/ INTERMEDIATE DISTRIBUTION FRAMES

A. Division 16 Electrical Contractor shall provide power for all equipment cabinets/racks. He shall provide distribution of electrical power within the equipment racks using two plugmold multi-outlet systems with receptacles mounted six inch on centers, (wiremold GB series). The extension of power circuits from ceiling area into the racks by the project’s electrical contractor shall be coordinated with the appropriate low voltage wiring contractor.

B. A line thermostat within the IDF cabinet set to open at 110 degrees Fahrenheit shall control the IDF power. (Use Dayton model # 4LZ94)

C. Dedicated electrical outlets must be installed for remote system amplifiers.

3.5 BOXES

A. MOUNTING
   1. With the exception of portable equipment, all boxes, conduits, cabinets, equipment and related wiring shall be held firmly in place and the mounting shall be plumb and square. All boxes shall be rigidly and securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.

B. WIRING
   1. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes shall be avoided. Where deemed necessary and approved, they shall be barred.

C. CLEANING
   1. Clean all box interiors thoroughly before installing plates, panels, or covers.

3.6 WIRING METHODS & PRACTICES

A. SUPERVISION
   1. Installation of all audio, video, control, and/or fiber cable to be provided under this scope of work is by this contractor. Supervision to include, but not be limited to ensuring proper:
      a. Pulling Tensions
b. Quantities
c. Types
d. Lengths
e. Routing
f. Wire Group Separation
g. Identification

B. IDENTIFICATION
1. All wires shall be permanently identified at each wire by marking with “E-Z” tape marker or equivalent, in a manner approved by the Architect.

C. TERMINAL BLOCKS
1. All terminal block connections shall be readily accessible. Not more than one wire connected to one terminal. Spare terminal blocks, equivalent to 10% of those in actual use shall be provided.

D. SPLICING
1. Splicing of cables is not permitted between terminations.

E. PULLING CABLE
1. Do not pull wire or cable through any, box fitting or enclosure where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius.
2. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during installation. Running of exposed cable in open ceiling area is not acceptable. Care shall be taken not to bend, crush or kink cables.
3. In modernization projects for rooms without ceilings, all cables must be concealed in raceway along the walls. Running of exposed cable in open ceiling area is not acceptable.
4. In rooms without ceilings where data cable is to be coiled for flexibility in relocating the data port, a junction box, 6 inches deep shall be installed for coiled cable storage. This junction box will be installed between truss area conduit and inner-wall conduit or truss area conduit and raceway.

F. CABLE SEPARATION
1. The categories, which are used to define the separation, distance between communications cable is as follows.
   a. Less than 1 Volt DC of signal level.
   b. 1 Volt to 25 Volts DC of signal level.
   c. 26 Volts DC and higher.
   d. RF Signals.
   e. Any type of AC Voltage cabling.
2. Telephone and data cables belong in the first category and can be run and installed together.
3. MATV and clock/intercom/security (CIS) signal cable belong in the second category, however because the MATV cable is a Radio Frequency (RF) based system it must be separated from the telephone, data and CIS cable by twelve inches. The CIS cable must be separated from telephone and data cables by six inches.

G. CABLE MANAGEMENT
1. Building Locations
   a. Comb straight and form in a neat and orderly manner all conductors in enclosures, boxes, wire paths, cable trays, and wiring troughs, providing circuit and conductor identification. For plenum air space support cable as required using caddy clips and j-hooks, or equivalent, of appropriate size and type. Tie wraps are not to be used for cable management or as cable supports.
2. Equipment Cabinets or Racks
a. Entry into the head end room or remote IDF(s) will be accomplished using ladder tray with appropriate cable roll-offs and cable management devices. Velcro cable ties of appropriate type and size are to be used to position cable within devices.

H. SERVICE LOOPS
1. Provide ample service loops at each termination so that plates, panels, and equipment can be dismounted for service and inspection. Provide the following as a minimum:
   a. Outlet box: Six (6) inches from wall surface to jack.
   b. Termination panel: Four (4) inches behind termination panel from last cable tie to jack.
   c. Fiber terminations: Two feet of service loop coiled and stored in junction box (minimum size 8”x8” box). Take care not to exceed bend radius of fiber.

I. WIRING HARNESSES
1. All wires and cables used in assembling custom panels and equipment racks shall be formed into harnesses, tied with Velcro tie wraps, and supported in accordance with accepted engineering practice. 2. Harnessed cables shall be combed straight. Each cable that breaks out from a harness for termination shall be provided with an ample service loop.
2. Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment.
3. Limit spacing between ties to six inches and provide circuit and conductor identification at least once in each enclosure.

J. FIBER OPTIC CABLE
1. All cable shall be installed, and terminated in accordance with the manufacturers recommended procedures. All cables will be terminated (see 16740, Section 2.3, C, 1 & 2) into their respective classroom terminals and central racks.

3.7 GROUNDING

A. GROUNDING PROCEDURE
1. The system wiring will conform to the following procedure:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment AC Ground Pins</td>
<td>Connect to AC ground.</td>
</tr>
<tr>
<td>Equipment Chassis</td>
<td>Connect to AC ground and/or rack frames.</td>
</tr>
<tr>
<td>Rack Frames</td>
<td>Connect to AC ground. Use insulated throat ground bushings for conduit connections.</td>
</tr>
<tr>
<td>Shielded Cable between AC powered equipment</td>
<td>Connect to ground at one end only.</td>
</tr>
<tr>
<td>Unbalanced Equipment</td>
<td>Float chassis from rack.</td>
</tr>
<tr>
<td>Conduit/Back Boxes</td>
<td>Isolate system wiring, including AC power, from all conduits and permanent backboxes.</td>
</tr>
<tr>
<td>AC Ground</td>
<td>Green wire (grounding conductor) system shall be installed on all conduit systems.</td>
</tr>
</tbody>
</table>

B. METALLIC CONDUIT & ENCLOSURES
1. All metallic conduit, boxes, and enclosures shall be permanently and effectively grounded in accordance with the National Electrical Code. Metallic enclosures containing active equipment shall be grounded with due regard for minimization of electrical noise.

3.8 EQUIPMENT CABINETS

A. GENERAL
1. The equipment cabinets shall be vented and considered as custom assemblies and
shall be assembled, wired, and tested in a properly equipped shop maintained by the contractor. Assembly of cabinets on site will not be permitted.

B. EQUIPMENT LOCATION
1. Placement of equipment in equipment cabinets is for maximum operator convenience. Verify any changes in placement prior to assembly. All system components and related wiring shall be located with due regard for the minimization of induced electromagnetic and electrostatic noise, for the minimization of wiring length, proper ventilation, and to provide reasonable safety and convenience for the operator. Fans shall be provided if required for proper ventilation. All cabling to the cabinets shall be ceiling accessible and within raceway extending from the cabinets/racks into the ceiling area.

C. RACK INSTALLATION
1. Racks shall be installed plumb and square without twists in the frames or variations in level between adjacent racks.

D. IDENTIFICATION
1. All terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled in a manner acceptable to the owner as to their function, circuit, or system as appropriate. Labeling on manufactured equipment shall be engraved plastic laminate with white lettering on black background or dark background that is similar to panel finish. Labeling of cable termination hardware shall be as that provided for by the manufacturer and typewritten. Handwritten identification is not permitted. See section 16740 for additional labeling requirements.

3.9 VERIFICATION TEST REPORT
A. Submit a written report detailing the results of initial adjustments and verification tests drawings, charts, and photographs. This report shall be completed and submitted for review at least five (5) days prior to acceptance testing. See the verification requirements in Sections 16740 and 16750.

3.10 ACCEPTANCE TESTING
A. The Acceptance Testing will be the responsibility of, and performed by the Contractor in the presence of the Owner, Architect, or the Owner’s representative. Coordinate this period so that free access, work lighting, and electric are available on the site. See the acceptance testing requirements Sections 16740 and 16750.

3.11 SYSTEM DOCUMENTATION
A. Prior to final acceptance tests, the Contractor shall submit to the Owner three copies of an operating and maintenance manual for the system that has been installed. These manuals will be used during the final acceptance testing of the system. Each manual shall contain the following information:
1. As-built drawings. Provide three copies.
2. Operation and maintenance manuals. Provide three copies.
3. Single line diagrams showing levels throughout system and impedances. Provide three copies.
SECTION 16936
MODULAR DIMMING CONTROLS - LUTRON

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Standalone lighting control systems and associated components:
   1. Fluorescent electronic dimming ballasts.
   2. LED drivers.
   3. Power interfaces.
   4. Main units (Lutron Grafik Eye QS).
   5. Lighting control modules (Lutron Energi Savr Node).
   6. Digital dimming driver and switching modules (Lutron EcoSystem).
   7. Control stations.
   8. Low-voltage control interfaces.
   10. Wireless sensors.
   11. Accessories.

1.2 RELATED REQUIREMENTS

A. Section 25130: Integrated Automation Control and Monitoring Network
B. Section 16195 - Electrical Identification
C. Section 16140 - Wiring Devices
   1. Finish requirements for wall controls specified in this section.
   2. Accessory receptacles and wallplates, to match lighting controls specified in this section.
D. Section 16510 - Interior Luminaires

1.3 REFERENCE STANDARDS

C. ANSI/ESD S20.20 - Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices); 2014.
E. CAL TITLE 24 P6 – California Code of Regulations, Title 24, Part 6 (California Energy Code); 2013.
F. IEC 60929 - AC and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements; 2015.
1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall controls with actual installed door swings.
3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
4. Where motorized window treatments are to be controlled by the lighting control system provided under this section, coordinate the work with other trades to provide compatible
products.
5. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Preinstallation Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
1. Low voltage wiring requirements.
2. Separation of power and low voltage/data wiring.
3. Wire labeling.
4. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
5. Control locations.
7. Connections to other equipment.
8. Installer responsibilities.

C. Sequencing:
1. Do not install sensors and wall controls until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. See Section 01330- Administrative Requirements for submittal procedures.

B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.

C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.

D. Shop Drawings:
1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.

E. Samples:
1. Wall Controls:
a. Show available color and finish selections.
b. Provide one sample(s) for each product.
2. Sensors: Provide one sample(s) for each product.
3. Mock-up: Provide an operating mock-up of one holding room control system that demonstrates the operational sequence of the lighting controls' ability to provide:
a. User defined circadian rhythm cycle with 30 minute on/off ramp up and down to simulate sunrise and sunset.
b. Switch to red light during night cycle using manual switch exterior to the room.
c. Switch corridor lighting to red when any holding, behavior or quarantine room is red.
F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. System Performance-Verification Documentation; Lutron LSC-SPV-DOC: Include as part of the base bid; as an alternate to the base bid additional costs for manufacturer's enhanced documentation detailing start-up performance-verification procedures and functional tests performed along with test results.

H. Project Record Documents: Record actual installed locations and settings for lighting control system components.

I. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

J. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications:
   1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.
   2. Registered to ISO 9001, including in-house engineering for product design activities.
   3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

D. Title 24 Acceptance Testing Technician Qualifications: Certified by a California approved Acceptance Test Technician Certification Provider as an Acceptance Test Technician (ATT) in accordance with CAL TITLE 24 P6.

E. Maintenance Contractor Qualifications: Manufacturer’s authorized service representative.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.
   1. System Requirements - Lutron, Unless Otherwise Indicated:
      a. Ambient Temperature:
         1) Lighting Control System Components, Except Those Listed Below: Between 32 and 104 degrees F (0 and 40 degrees C).
         2) Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).
      b. Relative Humidity: Less than 90 percent, non-condensing.
1.9 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer’s Standard Warranty, With Manufacturer Start-Up; *Lutron Standard 2-Year Warranty; Lutron LSC-B2*:
   1. Manufacturer Lighting Control System Components, Except Ballasts/Drivers and Driver Modules:
      a. First Two Years:
         1) 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
         2) First-available on-site or remote response time.
         3) Remote diagnostics for applicable systems.
      b. Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.
   2. Ballasts/Drivers and Driver Modules: Five years 100 percent parts coverage, no manufacturer labor coverage.

C. Include as part of the base bid; as an alternate to the base bid additional costs for manufacturer’s Enhanced Warranty with manufacturer Start-up; *Silver Enhanced Warranty; Lutron LSC-E8S*; coverage to include items listed under manufacturer’s standard warranty with manufacturer start-up above, plus the following upgrades:
   1. Manufacturer Lighting Control System Components, Except Ballasts/Drivers and Driver Modules:
      a. First Two Years:
         1) As-available Field Service response; no committed response time.
      b. Additional Coverage for Years 3-5: 50 percent replacement parts coverage, no manufacturer labor coverage.
      c. Additional Coverage for Years 6-8: 25 percent replacement parts coverage, no manufacturer labor coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Basis of Design Manufacturer: *Lutron Electronics Company, Inc; www lutron.com*.

A. Other Acceptable Manufacturers:
   1. Rees.
   2. Edstrom.
   3. Products by listed manufacturers are subject to compliance with specified requirements and prior approval of Architect.

B. Substitutions: See Section 01600 - Product Requirements.
   1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by Architect a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
   2. Any proposed substitutions to be reviewed by Architect at Contractor's expense at a rate of $200 per hour.
   3. By using pre-approved substitutions, Contractor accepts responsibility and associated costs for all required modifications to related equipment and wiring. Provide complete engineered shop drawings (including power wiring) with deviations from the original design highlighted in an alternate color for review and approval by Architect prior to rough-in.
C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

A. Sensor Layout and Tuning: Include as part of the base bid additional costs for Lighting Control Manufacturer's Sensor Layout and Tuning service; Lutron LSC-SENS-LT:
   1. Lighting Control Manufacturer to take full responsibility for wired or wireless sensor layout and performance for sensors provided by Lighting Control Manufacturer.
   2. Lighting Control Manufacturer to analyze the reflected ceiling plans, via supplied electronic AutoCAD format, and design a detailed sensor layout that provides adequate occupancy sensor coverage and ensures occupancy and daylight sensor performance per agreed upon sequence of operations. Contractor to utilize the layouts for sensor placement.
   3. During startup, Lighting Control Manufacturer to direct Contractor regarding sensor relocation, as required, should conditions require a deviation from locations specified in the drawings.
   4. Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits within one calendar year from Date of Substantial Completion to fine-tune sensor calibration per the agreed upon sequence of operations.

B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) as suitable for the purpose indicated.

C. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

D. Design lighting control equipment for 10 year operational life while operating continually at any temperature in an ambient temperature range of 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C) and 90 percent non-condensing relative humidity.

E. Electrostatic Discharge Tolerance: Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.

F. Dimming and Switching (Relay) Equipment:
   1. Designed so that electrolytic capacitors operate at least 36 degrees F (2 degrees C) below the capacitor's maximum temperature rating when the device is under fully loaded conditions at maximum rated temperature.
   2. Inrush Tolerance:
      a. Utilize load-handling thyristors (SCRs and triacs), field effect transistors (FETs) and isolated gate bipolar transistors (IGBTs) with maximum current rating at least two times the rated operating current of the dimmer/relay.
      b. Capable of withstanding repetitive inrush current of 50 times the operating current without impacting lifetime of the dimmer/relay.
   3. Surge Tolerance:
      a. Panels: Designed and tested to withstand surges of 6,000 V, 3,000 amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance.
      b. Other Power Handling Devices: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
   4. Power Failure Recovery: When power is interrupted and subsequently restored, within 3 seconds lights to automatically return to same levels (dimmed setting, full on, or full off) as prior to power interruption.
   5. Dimming Requirements:
      a. User defined circadian rhythm cycle with 30 minute on/off ramp up and down to simulate sunrise and sunset.
b. Switch to red light during night cycle using manual switch exterior to the room.
c. Switch corridor lighting to red when any holding, behavior or quarantine room is red.
d. Record status of lighting in each room at frequency determined by owner - nominally at 15 minute intervals.
e. Line Noise Tolerance: Provide real-time cycle-by-cycle compensation for incoming line voltage variations including changes in RMS voltage (plus or minus 2 percent change in RMS voltage per cycle), frequency shifts (plus or minus 2 Hz change in frequency per second), dynamic harmonics, and line noise.
   1) Systems not providing integral cycle-by-cycle compensation to include external power conditioning equipment as part of dimming system.
f. Incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
g. Utilize air gap off to disconnect the load from line supply.
h. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
i. Load Types:
   1) Assign a load type to each dimmer that will provide a proper dimming curve for the specific light source to be controlled.
   2) Provide capability of being field-configured to have load types assigned per circuit.
j. Minimum and Maximum Light Levels: User adjustable on a circuit-by-circuit basis.
k. Line Voltage Dimmers:
   1) Dimmers for Magnetic Low Voltage (MLV) Transformers:
      a) Provide circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472.
      b) Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.
   2) Dimmers for Electronic Low Voltage (ELV) Transformers: Operate transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
   3) Dimmers for Neon and Cold Cathode Transformers:
      a) Magnetic Transformers: Listed for use with normal (low) power factor magnetic transformers.
      b) Electronic Transformers: Must be supported by the ballast equipment manufacturer for control of specific ballasts being provided.
l. Low Voltage Dimming Modules:
   1) Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to a single zone.
   2) Single low voltage dimming module; capable of controlling the following light sources:
      a) 0-10V analog voltage signal.
         (1) Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
         (2) Sink current according to IEC 60929.
         (3) Source current.
      b) 10-0 V reverse analog voltage signal.
      c) DSI digital communication.
      d) DALI broadcast communication per IEC 60929:
         (1) Logarithmic intensity values complying with IEC 60929.
         (2) Linear intensity values for use with LED color intensity control.
e) PWM per IEC 60929.

6. Switching Requirements:
   a. Rated Life of Relays: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Switch load in a manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Provide output fully rated for continuous duty for inductive, capacitive, and resistive loads.

G. Device Finishes:
1. Wall Controls: Match finishes specified for wiring devices in Section 16140, unless otherwise indicated.
2. Standard Colors: Comply with NEMA WD1 where applicable.
3. Color Variation in Same Product Family: Maximum delta E of 1, CIE L*a*b color units.
4. Visible Parts: Exhibit ultraviolet color stability when tested with multiple actinic light sources as defined in ASTM D4674. Provide proof of testing upon request.

H. Interface with building automation system per Lutron System and Network Integration Consultation; LSC-INT-VISIT.
1. Record status of lighting in each room at frequency determined by owner - nominally at 15 minute intervals.

I. Interface with Existing Work.

2.3 LED DRIVERS

A. General Requirements:
1. Operate for at least 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
2. Provide thermal fold-back protection by automatically reducing power output (dimming) to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions that approach or exceed the LED driver's maximum operating temperature at calibration point.
3. Provide integral recording of operating hours and maximum operating temperature to aid in troubleshooting and warranty claims.
4. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2.
5. Manufactured in a facility that employs ESD reduction practices in compliance with ANSI/ESD S20.20.
6. UL 8750 recognized or listed as applicable.
7. UL Type TL rated where possible to allow for easier fixture evaluation and listing of different driver series.
8. UL 1598C listed for field replacement as applicable.
9. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
10. Class A sound rating; Inaudible in a 27 dBA ambient.
11. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.
12. LED drivers of the same family/series to track evenly across multiple fixtures at all light levels.
13. Offer programmable output currents in 10 mA increments within designed driver operating ranges for custom fixture length and lumen output configurations, while meeting a low-end dimming range of 100 to 1 percent or 100 to 5 percent as applicable.
14. Meet NEMA 410 inrush requirements.
15. Employ integral fault protection up to 277 V to prevent LED driver damage or failure in the event of incorrect application of line-voltage to communication link inputs.
16. LED driver may be remote located up to 100 feet (30 m) from LED light engine depending on power outputs required and wire gauge utilized by installer.
B. 3-Wire Control:
1. Provide integral fault protection to prevent driver failure in the event of a mis-wire.
2. Operate from input voltage of 120 V through 277 V at 50/60 Hz.

C. Digital Control (when used with compatible Lutron lighting control systems):
1. Employ power failure memory; LED driver to automatically return to the previous state/light level upon restoration of utility power.
2. Operate from input voltage of 120 V through 277 V at 50/60 Hz.
3. Automatically go to 100 percent light output upon loss of control link voltage and lock out system commands until digital control link voltage is restored. Manufacturer to offer UL 924 compliance achievable through use of external Lutron Model LUT-ELI-3PSH interface upon request.
4. Each driver responds independently per system maximum:
   a. Up to 32 occupant sensors.
   b. Up to 16 daylight sensors.
5. Responds to digital load shed command. (Example: If light output is at 30 percent and a load shed command of 10 percent is received, the driver automatically sets the maximum light output at 90 percent and lowers current light output by three percent to 27 percent).
6. Digital low-voltage control wiring capable of being wired as either Class 1 or Class 2.

D. Product(s):
1. 3-Wire and Digital Control, 0.1 Percent Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume Premier 0.1% Constant Voltage (L3D0-Series):
   a. Dimming Range: 100 to 0.1 percent measured output current.
   c. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.
   d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V and residential applications at 120 V.
   e. Total Harmonic Distortion (THD): Less than 20 percent at maximum power; complies with ANSI C82.11.
   f. UL Class 2 output designed to withstand hot swap of LED loads.
   g. Driver outputs to be short circuit protected, open circuit protected, and overload protected.
   h. Constant Voltage Drivers:
      1) Support for cove and under-cabinet fixtures at 24 V.
      a) Support LED arrays from 25 W to 96 W.
      b) Pulse Width Modulation (PWM) dimming frequency meets IEEE 1789.
      c) Meets solid state requirements for power factor, transient protection, standby power consumption (3-wire control only), and operating frequency in Energy Star for Luminaires Version 2.0.
      d) UL listed.
2. Forward Phase (Neutral Wire Required), One Percent Dimming; Lutron Hi-lume 1% (LTE-Series):
   a. Dimming Range: 100 to one percent relative light output.
   b. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial and residential applications at 120 V.
   c. Total Harmonic Distortion (THD): Less than 20 percent at full output for 40 W loads; complies with ANSI C82.11.
d. Constant Current Drivers:
   1) Support for downlights and pendant fixtures from 200 mA to 2.1 A to ensure a compatible driver exists.
      a) Support LED arrays up to 53 W.
      b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
      c) Models available that meet requirements for Energy Star compliance.
   2) Support for troffers, linear pendants, and linear recessed fixtures from 200 mA to 2.1 A to ensure a compatible driver exists.
      a) Support LED arrays up to 40 W.
      b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
      c) Models available that meet requirements for Energy Star compliance.
   3) Support for cove and under-cabinet fixtures from 200 mA to 2.1 A to ensure a compatible driver exists.
      a) Support LED arrays up to 40 W.
      b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
      c) UL listed.

e. Constant Voltage Drivers:
   1) Support for downlights and pendant fixtures from 10 V to 60 V (in 0.5 V steps) to ensure a compatible driver exists.
      a) Support LED arrays up to 40 W.
      b) Pulse Width Modulation (PWM) dimming method.
      c) Models available that meet requirements for Energy Star compliance.
   2) Support for troffers, linear pendants, and linear recessed fixtures from 10 V to 60 V (in 0.5 V steps) to ensure a compatible driver exists.
      a) Support LED arrays up to 40 W.
      b) Pulse Width Modulation (PWM) dimming method.
      c) Models available that meet requirements for Energy Star compliance.
   3) Support for cove and under-cabinet fixtures from 10 V to 60 V (in 0.5 V steps) to ensure a compatible driver exists.
      a) Support LED arrays up to 40 W.
      b) Pulse Width Modulation (PWM) dimming method.
      c) UL listed.

3. 3-Wire and Digital Control, One Percent Dimming: Lutron Hi-lume 1% (L3D-Series):
   a. Dimming Range: 100 to one percent relative light output.
   b. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120 V or 277 V.
   c. Total Harmonic Distortion (THD): Less than 20 percent at full output for loads greater than 25 W typical (higher for select models); complies with ANSI C82.11.
   d. Constant Current Drivers:
      1) Support for downlights and pendant fixtures from 200 mA to 2.1 A to ensure a compatible driver exists.
         a) Support LED arrays up to 53 W.
         b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
         c) Models available that meet requirements for Energy Star compliance.
      2) Support for troffers, linear pendants, and linear recessed fixtures from 200 mA to 2.1 A to ensure a compatible driver exists.
         a) Support LED arrays up to 40 W.
         b) Pulse Width Modulation (PWM) or Constant Current Reduction
3) Support for cove and under-cabinet fixtures from 200 mA to 2.1 A to ensure a compatible driver exists.
   a) Support LED arrays up to 40 W.
   b) Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available.
   c) Models available that meet requirements for Energy Star compliance.

4. Digital Control, Five Percent Dimming; Lutron 5-Series (LDE5-Series):
   a. Dimming Range: 100 to five percent measured output current.
   b. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.
   c. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V.
   d. Constant Current Reduction (CCR) dimming method.
   e. Total Harmonic Distortion (THD): Less than 21 percent at full load; complies with ANSI C82.11.
   f. Constant Current Drivers:
      1) Support for downlights and pendant fixtures from 10 V to 60 V (in 0.5 V steps) to ensure a compatible driver exists.
         a) Support LED arrays up to 40 W.
         b) Pulse Width Modulation (PWM) dimming method.
         c) Models available that meet requirements for Energy Star compliance.
      2) Support for troffers, linear pendants, and linear recessed fixtures from 10 V to 60 V (in 0.5 V steps) to ensure a compatible driver exists.
         a) Support LED arrays up to 40 W.
         b) Pulse Width Modulation (PWM) dimming method.
         c) Models available that meet requirements for Energy Star compliance.
      3) Support for cove and under-cabinet fixtures from 10 V to 60 V (in 0.5 V steps) to ensure a compatible driver exists.
         a) Support LED arrays up to 40 W.
         b) Pulse Width Modulation (PWM) dimming method.
         c) UL listed.

5. Digital Control, One Percent Dimming with Soft-On and Fade-to-Black Low End Performance; Lutron Hi-lume 1% Soft-on Fade-to-Black (LDE1-Series):
   a. Dimming Range: 100 to one percent measured output current.
   c. Typically dissipates 0.2 W standby power at 120 V and 0.3 W standby power at 277 V.
   d. Complies with FCC requirements of CFR, Title 47, Part 15, for commercial applications at 120-277 V.
   e. Employs true Constant Current Reduction (CCR) dimming method from 100 to
f. Pulse Width Modulation (PWM) frequency of 240 Hz.
g. Total Harmonic Distortion (THD): Less than 20 percent at full output for drivers greater than 25 W; complies with ANSI C82.11.
h. UL Class 2 output.
i. Driver outputs to be short circuit protected, open circuit protected, and overload protected.
j. Constant Current Driver; *Lutron K-Case Form Factor*: Support for fixtures from 220 mA to 1.4 A over multiple operating ranges.
   1) Support LED arrays up to 40 W.
   2) Models available that meet requirements for Energy Star compliance.
k. Constant Current Driver; *Lutron M-Case Form Factor*: Support for fixtures from 150 mA to 2.1 A over multiple operating ranges.
   1) Support LED arrays up to 75 W.
   2) Models available to meet the DesignLights Consortium (DLC) power line quality requirements.

2.4 **POWER INTERFACES**

A. Provide power interfaces as indicated or as required to control the loads as indicated.

B. **General Requirements:**
   1. Phase independent of control input.
   2. Rated for use in air-handling spaces as defined in UL 2043.
   3. Utilize air gap off to disconnect the load from line supply.
   4. Diagnostics and Service: Replacing power interface does not require re-programming of system or processor.

C. **Product(s):**
   1. Phase-Adaptive Power Module; *Lutron PHPM-PA*: Provides interface for phase control input to provide full 16 A circuit output of forward/reverse phase control for compatible loads.
   2. 3-Wire Fluorescent Power Module; *Lutron PHPM-3F*: Provides interface for phase control input to provide full 16 A circuit output for compatible line-voltage control fluorescent electronic dimming ballasts or LED drivers.
   3. Switching Power Module; *Lutron PHPM-SW*: Provides interface for phase control or switched input to provide full 16 A circuit output of switching for compatible non-dim loads.
   4. Phase-Adaptive Power Module with 3-Wire Fluorescent/LED Input; *Lutron PHPM-WBX*: Provides interface for fluorescent ballast/LED driver control input to provide full 16 A circuit output for compatible loads.
   5. Ten Volt Interface; *Lutron GRX-TVI*: Provides interface for phase control input to provide full 16 A circuit output of switching and 0-10 V low voltage control for compatible fluorescent electronic dimming ballasts or LED drivers.

2.5 **MAIN UNITS (LUTRON GRAFIK EYE QS)**

A. **Product:** Lutron GRAFIK Eye QS.

B. **Provide main units with configuration and quantity of zones as indicated or as required to control the loads as indicated.**

C. **Finish:** As specified for wall controls in "Device Finishes" under LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.
D. Engrave units with button, zone, and scene descriptions as indicated on the drawings

E. Integrated Wireless Capability:
   1. Provide wireless communication inputs for:
      a. Occupancy sensors.
      b. Daylight sensors.
      c. Wireless controller.
   2. RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).
   3. RF Frequency: 434 MHz; operate in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.

F. Preset Lighting Control with Zone Override:
   1. Intensity for each zone indicated by means of one illuminated bar graph per zone.
   2. User-programmable zone and scene names.
   3. Utilize air gap off to disconnect the load from line supply.
   4. Astronomical time clock and programmer interface provides access to:
      a. Scene selections.
      b. Fade zone to a level.
      c. Fine-tuning of preset levels with scene raise/lower.
      d. Lock out scenes and zones.
      e. Fine-tuning of light levels with individual zone raise/lower.
      f. Terminal block for wired infrared signal input.
      g. Enable/disable wall station.
   5. Light intensity with real time energy savings by digital display.
   6. Fade time indicated by digital display for current scene while fading.
   7. Integral wide angle infrared receiver.
   8. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.
   9. Direct Low-Voltage Control of Digital Ballasts and LED drivers (120 V, 220/240 V, 277 V and/or 347 V Lighting):
      a. Electronically link a digital fluorescent lighting ballast to a zone for both dimming and turning on/off.
      b. Electronically assign daylight sensors to digital ballasts and line voltage dimmers for proportional daylight harvesting.
      c. Single integral controller with Class 1 or Class 2 isolated digital output signal conforming to IEC 60929; capable of direct control without interface.
   10. Creates daylighting rows independent of control zones.
   11. Capable of re-zoning without re-wiring using programming display on unit.
   12. Outputs can be virtually mapped to other device’s outputs.
   13. Zone raise/lower buttons capable of controlling local lighting loads connected to the main unit or remote lighting zones in the system.

G. Preset Shade Control with Zone Override:
   1. Preset expandable shade control: Provide up to three columns of shade control.
   2. For temporary local overrides, individual raise/lower buttons to allow zones to be adjusted without altering scene values stored in memory.

H. Provides one direct-wired occupancy sensor connection without interface or power pack.

2.6 LIGHTING CONTROL MODULES (LUTRON ENERGI SAVR NODE)

A. Provide lighting control modules as indicated or as required to control the loads as indicated.

B. General Requirements:
1. Listed to UL 508 as industrial control equipment.
2. Delivered and installed as a listed factory-assembled panel.
3. Passively cooled via free-convection, unaided by fans or other means.
5. Connection without interface to wired:
   a. Occupancy sensors.
   b. Daylight sensors.
   c. IR receivers for personal control.
6. LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.
7. Contact Closure Input:
   a. Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
      1) Activate scenes.
         a) Scene activation from momentary or maintained closure.
      2) Enable or disable after hours not required - 24/7 facility operation.
         a) Automatic sweep to user-specified level after user-specified time has elapsed.
         b) System will provide occupants a visual warning prior to sweeping lights to user-specified level.
         c) Occupant can reset timeout by interacting with the lighting system.
      3) Activate or deactivate demand response (load shed) - not required; entire facility is on generator backup.
         a) Load shed event will reduce lighting load by user-specified amount.
8. Emergency Contact Closure Input:
   a. Maintain all zones at pre-emergency levels during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
   b. Allow configurable zone response during emergency state.
   c. Maintain control operation until emergency signal is cleared.
9. Supplies power for control link for keypads and control interfaces.
10. Distributes sensor data among multiple lighting control modules.
11. Capable of being controlled via wireless sensors and controls.

C. Switching Lighting Control Modules:
1. Product(s):
   a. Lutron SoftSwitch Energi Savr Node; Model QSN-4S16-S: 16 A continuous-use per channel.
   b. Lutron SoftSwitch Energi Savr Node; Model QSN-4S20-S: 20 A (16 A driver) continuous-use per channel.
2. Switching:
   a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
   d. Module to integrate up to four individually controlled zones.
   e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

D. 0-10V Lighting Control Modules:
1. Product(s):
   a. Lutron 0-10 V Energi Savr Node; Model QSN-4T16-S: 16 A continuous-use per channel.
   b. Lutron 0-10 V Energi Savr Node; Model QSN-4T20-S: 20 A (16 A driver) continuous-use per channel.
2. Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.

3. Single low voltage dimming module; capable of controlling following light sources:
   a. 0-10 V analog voltage signal.
      1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
      2) Sink current per IEC 60929.
   b. 10-0 V analog voltage signal.
      1) Provide Class 2 isolated 0-10 V output signal conforming to IEC 60929.
      2) Sink current per IEC 60929.

4. Switching:
   a. Rated Life of Relay: Typical of 1,000,000 cycles at fully rated 16 A for all lighting loads.
   b. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
   c. Fully rated output continuous duty for inductive, capacitive, and resistive loads.
   d. Module to integrate up to four individually controlled zones.
   e. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

E. Digital Fixture Lighting Control Modules:
   1. Product(s):
      a. Lutron EcoSystem Energi Savr Node; Model QSN-1ECO-S: One EcoSystem Digital Link.
      b. Lutron EcoSystem Energi Savr Node; Model QSN-2ECO-S: Two EcoSystem Digital Links.
   2. Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and ballast/driver failure reporting.
   3. Provide testing capability using manual override buttons.
   4. Each low-voltage digital communication link to support up to 64 ballasts or LED drivers capable of NFPA 70 Class 1 or Class 2 installation.

2.7 DIGITAL DIMMING DRIVERS AND SWITCHING MODULES (LUTRON ECOSYSTEM)

A. Provide digital dimming driver and switching modules as indicated or as required to control the loads as indicated.

B. General Requirements:
   1. Provide continuous 3-wire signal dimming to compatible 3-wire electronic dimming drivers.
   2. Utilize air gap off to disconnect the load from line supply.
   3. Connect without interface to:
      a. Occupancy sensor.
      b. Daylight sensor.
      c. Personal control input (wall station or infrared receiver).
   4. Generate digital communication commands to distribute driver and sensor data on the digital bus.
   5. If power is interrupted and subsequently restored, lights automatically return to the setting prior to the power interruption.
   6. Each driver module responds independently to:
      a. Up to 32 occupancy sensors.
      b. Up to 64 personal control inputs.
      c. Two daylight sensors.
   7. Unique internal reference number visible displayed on module cover.
   8. Averages two independent daylight harvesting inputs internally.
      a. Sets high end trim.
      b. Automatically scales light output proportional to load shed command. (Example:
If light output is at 30 percent and a load shed command of 10 percent is received, the driver to automatically set the maximum light output at 90 percent and lower current light output by 3 percent to 27 percent).

10. Provide integral fault protection to prevent driver module failure in the event of a miswire.

C. Product(s):

1. 3-Wire Driver Module, 2 Amp; Lutron EcoSystem Model C5-BMF-2A:
   a. Integrates up to 2 amps of 3-wire electronic dimming drivers into EcoSystem digital control system as a single zone.

2. 3-Wire Driver Module, 16 Amp; Lutron EcoSystem Model C5-BMJ-16A:
   a. Integrates up to 16 amps of 3-wire electronic dimming drivers into EcoSystem digital control system as a single zone.
   b. Integrates up to 16 amps of switched high intensity discharge (HID) lighting load into EcoSystem digital control system as a single zone.

3. Switching Power Module, 16 Amp; Lutron EcoSystem Model C5-XPJ-16A:
   a. Integrates up to 16 amps of high in-rush lighting load (magnetic fluorescent ballast, electronic fluorescent ballast, HID, incandescent, magnetic low-voltage, electronic low-voltage, neon/cold cathode and motor loads) into EcoSystem digital control system as a single zone.

2.8 CONTROL STATIONS

A. Provide control stations with configuration as indicated or as required to control the loads as indicated.

B. Wired Control Stations:

1. General Requirements:
   a. Power: Class 2 (low voltage).
   b. UL listed.
   c. Provide faceplates with concealed mounting hardware.
   d. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
   e. Finish: As specified for wall controls in "Device Finishes" under LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.

2. Multi-Scene Wired Control:
   a. General Requirements:
      1) Allows control of any devices part of the lighting control system.
      2) Allows for easy reprogramming without replacing unit.
      3) Replacement of units does not require reprogramming.
      4) Communications: Utilize RS485 wiring for low-voltage communication.
      5) Engrave keypads with button, zone, and scene descriptions as indicated on the drawings.
      6) Software Configuration:
         a) Customizable control station device button functionality:
            (1) Buttons can be programmed to perform single defined action.
            (2) Buttons can be programmed to perform defined action on press and defined action on release.
            (3) Buttons can be programmed using conditional logic off of a state variable such as time of day or partition status.
            (4) Buttons can be programmed to perform automatic sequence of defined actions.
            (5) Capable of deactivating select keypads to prevent
accidental changes to light levels.

(6) Buttons can be programmed for raise/lower of defined loads.

(7) Buttons can be programmed to toggle defined set of loads on/off.

7) Status LEDs:
   a) Upon button press, LEDs to immediately illuminate.
   b) LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or LEDs to turn off if the button press was not processed.
   c) Support logic that defines when LED is illuminated:
      (1) Scene logic (logic is true when all zones are at defined levels).
      (2) Room logic (logic is true when at least one zone is on).
      (3) Pathway logic (logic is true when at least one zone is on).
      (4) Last scene (logic is true when spaces are in defined scenes).

b. Wired Keypads; Lutron seeTouch QS Keypads:
   1) Style: Architectural Insert Style.
   2) Communications: Utilize RS485 wiring for low-voltage communications link.
   3) Mounting: Wallbox or low-voltage mounting bracket; provide wall plates with concealed mounting hardware.
   4) Button/Engraving Backlighting:
      a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
      b) Backlight intensity adjustable via programming software.
   5) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
   6) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
   7) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.
   8) Provide integral infrared receiver for personal control where indicated.

c. Wired Keypads; Lutron Architrave QS Keypads:
   1) Mounting: Wallbox; Lutron Architrave Wallbox; provide wall plates with concealed mounting hardware.
   2) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
   3) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
   4) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

d. Wired Keypads; Lutron Signature Series QS Keypads:
   1) Mounting: Wallbox; Lutron Signature Series Wallbox; provide wall plates with concealed mounting hardware.
   2) Button/Engraving Backlighting:
      a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
      b) Backlight intensity adjustable via programming software.
   3) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
   4) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
5) Terminal block inputs to be over-voltage and miswire-protected against wire reversals and shorts.

3. Single-Scene or Zoned Wired Control:
   b. Turn an individual fixture or group of fixtures on and off.
   c. Raise and lower light levels.
   d. Recall favorite light levels.

4. Four-Button Preset Wallstation:
   a. Product: Lutron EcoSystem CC-4BRL Four-Button Control.
   b. Recall four scenes plus all on or all off for one group of fixtures.
   c. Master raise/lower control for entire group of fixtures.
   d. Integral IR receiver for personal control.
   e. Immediate local LED response upon button activation to indicate that a system command has been requested.

5. Wired Keyswitch:
   b. Configuration:
      1) Three position, maintained, center position key removal; Lutron Model QSWS2-KSI-3MAC.
      2) Two position, maintained, center position key removal; Lutron Model QSWS2-KSI-2MAC.
      3) Two position, maintained, any position key removal; Lutron Model QSWS2-KSI-2MAA.
   c. Allows control of any devices part of the lighting control system.
   d. Utilize RS485 wiring for low-voltage communication.
   e. Functionality:
      1) Allows for easy reprogramming without replacing unit.
      2) Requires key insertion to activate actions.
   f. Engrave keypads with button, zone, and scene descriptions as indicated on the drawings.
   g. Software Configuration:
      1) Customizable control station device button functionality:
         a) Key positions can be programmed to perform single defined action.
         b) Key positions can be programmed using conditional logic off of a state variable such as time of day or partition status.

2.9 LOW-VOLTAGE CONTROL INTERFACES

A. Provide low-voltage control interfaces as indicated or as required to control the loads as indicated.

B. UL listed.

C. Contact Closure Interface:
   1. Product: Lutron Model QSE-IO.
   2. The contact closure input device to accept both momentary and maintained contact closures.
   3. The contact closure output device can be configured for maintained or pulsed outputs.
   4. Contact closure can be programmed using conditional logic off of a state variable such as time of day or partition status.

D. Wallbox Input Closure Interface:
   1. Product: Lutron Model QSE-CI-WCI.
   2. Mounts in wallbox behind contact closure keypad to provide interface for up to eight contact closure inputs.
   3. The contact closure input device to accept both momentary and maintained contact
E. RS232 and Ethernet Interface:
1. Product: Lutron Model QSE-CI-NWK-E.
2. Provide ability to communicate via Ethernet or RS232 to audiovisual equipment, touchscreens, etc.
3. Provide control of:
   a. Light scene selections.
   b. Fine-tuning of light scene levels with raise/lower.
   c. Fine-tuning of shade preset levels with raise/lower.
   d. Simulate system wall station button presses and releases.
4. Provide status monitoring of:
   a. Light scene status.
   b. Wall station button presses and releases.
   c. Wall station LEDs.
5. Provide ability to send custom output strings.

F. DMX Interface:
1. Product: Lutron Model QSM-CI-DMX.
2. Provide ability to:
   a. Map a single zone intensity to a single DMX512 lighting channel.
   b. Map a single zone intensity to three DMX512 channels for RGB/CYM color control.
   c. Map a single zone intensity to a single DMX512 integration channel.
   d. Smoothly transition from one color to another in a cross fade.
   e. Automatically sequence through a variety of colors.
   f. Download, program, and customize a color wheel for each unit.

G. Sensor Modules:
1. Products:
   a. Sensor module with both wired and wireless inputs; Lutron Model QSM2-4W-C.
   b. Sensor module with wired inputs only; Lutron Model QSMX-4W-C.
   c. Sensor module with wireless inputs only; Lutron Model QSM2-XW-C.
2. Wired Modules:
   a. Provide wired inputs for:
      1) Occupancy sensors.
      2) Daylight sensors.
      3) IR receivers for personal control.
      4) Digital driver wall stations.
3. Wireless Modules:
   a. Provide wireless communication inputs for:
      1) Occupancy sensors.
      2) Daylight sensors.
      3) Wireless controller.
   b. RF Range: 30 feet (9 m) between sensor and compatible RF receiving devices.
   c. RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
4. Communicate sensor information to wired low-voltage digital link for use by compatible devices.

2.10 WIRED SENSORS

A. Wired Occupancy Sensors:
1. General Requirements:
   a. Connects directly to compatible drivers and modules without the need of a power pack or other interface.
   b. Turns off or reduces lighting automatically after reasonable time delay when a room or area is vacated by the last person to occupy the space.
c. Accommodates all conditions of space utilization and all irregular work hours and habits.
d. Comply with UL 94.
e. Self-Adaptive Sensors: Continually adjusts sensitivity and timing to ensure optimal lighting control for any use of the space; furnished with field-adjustable controls for time delay and sensitivity to override any adaptive features.
f. Provide capability to:
   1) Add additional timeout system-wide without need to make local adjustment on sensor.
   2) Group multiple sensors.
g. Power Failure Memory: Settings and learned parameters to be saved in non-volatile memory and not lost should power be interrupted and subsequently restored.
h. Furnished with all necessary mounting hardware and instructions.
i. Class 2 devices.

2. Wired Passive Infrared Sensors:
   a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
   c. Product(s):
      1) Ceiling-Mounted Passive Infrared Sensor, 450 square feet (42 sq m); Lutron Model LOS-CIR-450-WH; or Lutron Model ULOS-CIR-450-WH (BAA-Buy American Act Compliant): Coverage of 450 square feet (42 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.
      2) Ceiling-Mounted Passive Infrared Sensor, 1500 square feet (140 sq m); Lutron Model LOS-CIR-1500-WH; or Lutron Model ULOS-CIR-1500-WH (BAA-Buy American Act Compliant): Coverage of 1500 square feet (140 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.
      3) Wall-Mounted Passive Infrared Sensor; Lutron Model LOS-WIR-WH; or Lutron Model ULOS-WIR-WH (BAA-Buy American Act Compliant): Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; self-adaptive.
      4) High Bay Passive Infrared Sensor, Surface-Mounted, 180 Degree; Lutron Model LUT-WSPSM24V-180-CPN6111: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 180 degree field of view; field-adjustable timeout.
      5) High Bay Passive Infrared Sensor, Surface-Mounted, 360 Degree; Lutron Model LUT-WSPSM24V-360-CPN6111: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 360 degree field of view; field-adjustable timeout.
      6) High Bay Passive Infrared Sensor, End-Mounted, 180 Degree; Lutron Model LUT-WSPSM24V-180-CPN6112: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 180 degree field of view; field-adjustable timeout.
      7) High Bay Passive Infrared Sensor, End-Mounted, 360 Degree; Lutron Model LUT-WSPSM24V-360-CPN6112: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 360 degree field of view; field-adjustable timeout.
8) High Bay Passive Infrared Sensor, Fixture-Mounted, 360 Degree; Lutron Model FHB140NP24V-CPN5190: Coverage radius of 42 feet (13 m) at mounting height of 30 feet (9 m) and 50 feet (15 m) at mounting height of 45 feet (14 m); 360 degree field of view; field-adjustable sensitivity and timeout; customizable mask for aisle and end of aisle applications.

3. Wired Ultrasonic Sensors:
   a. Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   b. Product(s):
      1) Ceiling-Mounted Ultrasonic Sensor, 500 square feet (46 sq m); Lutron Model LOS-CUS-500-WH; or Lutron Model ULOS-CUS-500-WH (BAA-Buy American Act Compliant): Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.
      2) Ceiling-Mounted Ultrasonic Sensor, 1000 square feet (93 sq m); Lutron Model LOS-CUS-1000-WH; or Lutron Model ULOS-CUS-1000-WH (BAA-Buy American Act Compliant): Coverage of 1,000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.
      3) Ceiling-Mounted Ultrasonic Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CUS-2000-WH; or Lutron Model ULOS-CUS-2000-WH (BAAA-Buy American Act Compliant): Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.

4. Wired Dual Technology Sensors:
   a. Passive Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   b. Ultrasonic: Utilize an operating frequency of 32 kHz or 40 kHz, crystal-controlled to operate within plus/minus 0.005 percent tolerance.
   c. Ceiling-Mounted Sensors: Provide customizable mask to block off unwanted viewing areas.
   d. Isolated Relay: Provide an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options where indicated.
   e. Integral Photocell: Provide an integral photocell with adjustable sensitivity to prevent lights from turning on when there is sufficient natural light where indicated.
   f. Product(s), Without Isolated Relay and Integral Photocell:
      1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); Lutron Model LOS-CDT-500-WH; or Lutron Model ULOS-CDT-500-WH (BAA-Buy American Act Compliant): Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.
      2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); Lutron Model LOS-CDT-1000-WH; or Lutron Model ULOS-CDT-1000-WH (BAAA-Buy American Act Compliant): Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; self-adaptive.
      3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CDT-2000-WH; or Lutron Model ULOS-CDT-2000-WH (BAA-Buy American Act Compliant): Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; self-adaptive.
      4) Wall-Mounted Dual Technology Sensor; Lutron Model LOS-WDT-WH; or Lutron Model ULOS-WDT-WH (BAA-Buy American Act Compliant: Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; self-adaptive.
g. Product(s), With Isolated Relay and Integral Photocell:

1) Ceiling-Mounted Dual Technology Sensor, 500 square feet (46 sq m); Lutron Model LOS-CDT-500R-WH; or Lutron Model ULOS-CDT-500R-WH (BAA-Buy American Act Compliant): Coverage of 500 square feet (46 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; with isolated relay and integral photocell; self-adaptive.

2) Ceiling-Mounted Dual Technology Sensor, 1000 square feet (93 sq m); Lutron Model LOS-CDT-1000R-WH; or Lutron Model ULOS-CDT-1000R-WH (BAAA-Buy American Act Compliant): Coverage of 1000 square feet (93 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 180 degree field of view; with isolated relay and integral photocell; self-adaptive.

3) Ceiling-Mounted Dual Technology Sensor, 2000 square feet (186 sq m); Lutron Model LOS-CDT-2000R-WH; or Lutron Model ULOS-CDT-2000R-WH (BAA-Buy American Act Compliant): Coverage of 2000 square feet (186 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view; with isolated relay and integral photocell; self-adaptive.

4) Wall-Mounted Dual Technology Sensor; Lutron Model LOS-WDT-R-WH; or Lutron Model ULOS-WDT-R-WH (BAA-Buy American Act Compliant: Coverage of 1600 square feet (149 sq m) with ceiling height of 8 to 12 feet (2.4 to 3.7 m); 110 degree field of view; with isolated relay and integral photocell; self-adaptive.

B. Sensor Power Packs:

1. Product(s):
   a. 347 VAC power input/24 VDC, 100 mA power output; 15 A driver (347 V) relay contact rating; Lutron Model PP-347H Power Pack; or Lutron Model UPP-347H Power Pack (BAA-Buy American Act Compliant).
   b. 120-277 VAC power input/24 VDC, 150 mA power output; 16 A lighting (120-277 V), 1 HP motor (120-277 V) relay contact rating; Lutron Model PP-DV Power Pack; or Lutron Model UPP-DV Power Pack (BAA-Buy American Act Compliant).
   c. 120-277 VAC power input (manual)/24 VDC, 150 mA power output; 16 A lighting (120-277 V), 1 HP motor (120-277 V) relay contact rating; Lutron Model PP-DV-M Power Pack; or Lutron Model UPP-DV-M Power Pack (BAA-Buy American Act Compliant).
   d. Control relay only (no power input/output); requires another power pack for power and counts as one of three sensors connected to a power pack; 16 A lighting (120-277 V), 1 HP motor (120-277 V), 15 A driver (347 V) relay contact rating; Lutron Model PP-SH Power Pack; or Lutron Model UPP-SH Power Pack (BAA-Buy American Act Compliant).

2. Provide sensor power packs where required for power connection to sensors.

3. For ease of mounting, installation and future service, power pack(s) to be able to mount through a 1/2 inch knockout in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer to provide power to a minimum of three sensors.

4. Plenum-rated.

5. Control Wiring Between Sensors and Control Units: Class 2, 18-24 AWG, stranded UL Classified, PVC insulated or TEFOLON jacketed cable suitable for use in plenums, where applicable.

C. Infrared Receivers:

1. Product: Lutron Model EC-IR-WH.

2. Use Class 2 wiring for low voltage communication.

3. Can be replaced without reprogramming.

4. 360 degree reception of wireless infrared remote controls.
5. Immediate local LED response upon reception of handheld transmitter communication.
6. Mountable on lighting fixtures or recessed acoustical ceiling tiles.
7. Constructed via sonic welding.

D. Wired Daylight Sensors:
1. Digital Interior Daylight Sensor:
   a. Product: Lutron Model EC-DIR-WH.
   b. Use Class 2 wiring for low voltage communication.
   c. Can be replaced without reprogramming.
   d. Open-loop basis for daylight sensor control scheme.
   e. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
   f. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
   g. Provide linear response from 0 to 500 footcandles.
   h. Integral IR receiver for personal control.
   i. Mountable on lighting fixtures or recessed acoustical ceiling tiles.
   j. Constructed via sonic welding.
2. Daylight Control Package:
   b. Controller:
      1) Product: Lutron Model LC8.
      2) Automatically switches a dry contact according to changes in ambient light levels.
      3) Fully adjustable separate high and low setpoints, with an adjustable dead band between set points to prevent unwanted cycling.
      4) Input time delay to prevent unwanted cycling due to intermittent light level fluctuations.
      5) Signal/setpoint and relay status indication.
      6) Sensor calibration input.
   c. Sensors:
      1) Class 2, three-wire analog devices.
      2) Provision for zero or offset based signal.
      3) Indoor Photo Sensors; Lutron Model CES/I: With fresnel lens and 60 degree cone of response; sensor range of 0 to 750 footcandles.
      4) Outdoor Photo Sensors; Lutron Model CES/O: Weatherproof, with hood over aperture to shield sensor from direct sunlight; sensor range of 0 to 750 footcandles.
      5) Atrium Photo Sensors; Lutron Model CES/A: With translucent dome and 180 degree field of view; sensor range of 2 to 2,500 footcandles.
      6) Skylight Photo Sensors; Lutron Model CES/S: With translucent dome and 180 degree field of view; sensor range of 10 to 7,500 footcandles.

E. Infrared Partition Sensors:

   Product: Lutron Model GRX-IRPS-WH.
   A. Provide contact closure based on status of the partition wall (open/close) enabling automatic linking of controls.

2.11 WIRELESS SENSORS

A. General Requirements:
   1. Operational life of 10 years without the need to replace batteries when installed per manufacturer's instructions.
   2. Communicates directly to compatible RF receiving devices through use of a radio
frequency communications link.

3. Does not require external power packs, power wiring, or communication wiring.
4. Capable of being placed in test mode to verify correct operation from the face of the unit.
5. RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).

B. Wireless Occupancy/Vacancy Sensors:
   1. General Requirements:
      a. Provides a clearly visible method of indication to verify that motion is being detected during testing and that the unit is communicating to compatible RF receiving devices.
      b. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
      c. Sensing Mechanism: Passive infrared coupled with technology for sensing fine motions; Lutron XCT Technology. Signal processing technology detects fine-motion passive infrared (PIR) signals without the need to change the sensor's sensitivity threshold.
      d. Provide optional, readily accessible, user-adjustable controls for timeout, automatic/manual-on, and sensitivity.
      e. Turns off lighting after reasonable and adjustable time delay once the last person to occupy the space vacates a room or area. Provide adjustable timeout settings of 1, 5, 15, and 30 minutes.
      f. Capable of turning dimmer's lighting load on to an optional locked preset level selectable by the user. Locked preset range to be selectable on the dimmer from 1 percent to 100 percent.
      g. Color: White.
      h. Provide all necessary mounting hardware and instructions for both temporary and permanent mounting.
      i. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be design for easy, damage-free removal.
      j. Sensor lens to illuminate during test mode when motion is detected to allow installer to verify coverage prior to permanent mounting.
      k. Ceiling-Mounted Sensors:
         1) Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
         2) Provide recessed mounting bracket compatible with drywall and compressed fiber ceilings.
         3) Provide customizable mask to block off unwanted viewing areas.
      l. Wall-Mounted Sensors: Provide wall or corner mounting brackets compatible with drywall and plaster walls.

2. Wireless Combination Occupancy/Vacancy Sensors:
   a. Ceiling-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), an occupancy sensor with low light feature (automatic-on when less than one footcandle of ambient light available and automatic-off), or a vacancy sensor (manual-on and automatic-off).
   b. Wall-Mounted Sensors: Programmable to operate as an occupancy sensor (automatic-on and automatic-off), or a vacancy sensor (manual-on and automatic-off).
   c. Product(s):
      1) Ceiling-Mounted Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OCR2B-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OCR2B-P-WH (BAA-Buy American Act Compliant): Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.
2) Wall-Mounted Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OWLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OWLB-P-WH (BAA-Buy American Act Compliant): Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 180 degree field of view.

3) Corner-Mounted Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OKLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OKLB-P-WH (BAA-Buy American Act Compliant): Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.

4) Hallway Occupancy/Vacancy Sensor; Lutron Radio Powr Savr Series, Model LFR2-OHLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-OHLB-P-WH (BAA-Buy American Act Compliant): Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.

3. Wireless Vacancy-Only Sensors:
   a. Operates only as a vacancy sensor (manual-on and automatic-off) in accordance with CAL TITLE 24 P6 requirements.
   b. Product(s):
      1) Ceiling-Mounted Vacancy-Only Sensor; Lutron Radio Powr Savr Series, Model LFR2-VCR2B-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VCR2B-P-WH (BAA-Buy American Act Compliant): Coverage from 324 square feet (30.2 sq m) to 676 square feet (62.4 sq m) depending on ceiling height from 8 to 12 feet (2.4 to 3.7 m); 360 degree field of view.
      2) Wall-Mounted Vacancy-Only Sensor; Lutron Radio Powr Savr Series, Model LFR2-VWLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VWLB-P-WH (BAA-Buy American Act Compliant): Minor motion coverage of 1500 square feet (139.4 sq m) and major motion coverage of 3000 square feet (278.7 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 180 degree field of view.
      3) Corner-Mounted Vacancy-Only Sensor; Lutron Radio Powr Savr Series, Model LFR2-VKLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VKLB-P-WH (BAA-Buy American Act Compliant): Minor motion coverage of 1225 square feet (113.8 sq m) and major motion coverage of 2500 square feet (232.3 sq m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); 90 degree field of view.
      4) Hallway Vacancy-Only Sensor; Lutron Radio Powr Savr Series, Model LFR2-VHLB-P-WH; or Lutron Radio Powr Savr Series, Model ULFR2-VHLB-P-WH (BAA-Buy American Act Compliant): Major motion coverage of up to 150 feet (45.7 m) with mounting height of 6 to 8 feet (1.8 to 2.4 m); narrow field of view.

C. Wireless Daylight Sensors:
   1. Product: Lutron Model LFR2-DCRB.
   2. Open-loop basis for daylight sensor control scheme.
   3. Stable output over temperature from 32 degrees F (0 degrees C) to 104 degrees F (40 degrees C).
   4. Partially shielded for accurate detection of available daylight to prevent fixture lighting and horizontal light component from skewing sensor detection.
   5. Provide linear response from 0 to 10,000 footcandles.
   7. Mounting:
      a. Provide surface mounting bracket compatible with drywall, plaster, wood, concrete, and compressed fiber ceilings.
      b. Provide all necessary mounting hardware and instructions for both temporary
and permanent mounting.
c. Provide temporary mounting means to allow user to check proper performance and relocate as needed before permanently mounting sensor. Temporary mounting method to be designed for easy, damage-free removal.

8. Meets CAL TITLE 24 P6 requirements.

2.12 ACCESSORIES

A. Emergency Lighting Interface:
1. Product: Lutron Model LUT-ELI.
2. Provides total system listing to UL 924 when used with lighting control system.
3. Senses all three phases of building power.
4. Provides an output to power panels or digital driver interfaces if power on any phase fails and sends all lights controlled by these devices the light level setting prior to the power failure. Lights to return to their previous intensities when normal power is restored.
5. Accepts a contact closure input from a fire alarm control panel.

B. Provide power supplies as indicated or as required to power system devices and accessories.
1. Product(s):
   a. Junction box-mounted power supply for shades, keypads, and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-J-1-50; with miswire and thermal protection.
   b. Plug-in power supply for shades, drapery drive units, keypads, and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-P1-1-35V; with miswire protection; powered from standard receptacle using cord 6 feet (1.8 m) in length; complies with DOE Level VI regulation.
   c. Ten output power supply panel for shades, drapery drive units, keypads and accessories, and for providing additional low voltage power to communication link; Lutron Model QSPS-10PNL; no replaceable fuses required for overload/miswire protection; contains DOE Level VI Compliant power supplies.
   d. Power supply for keypads and accessories (not for shades/window treatments), and for providing additional low voltage power to communication link; Lutron Model QSPS-DH-1-75.

C. Provide locking covers for controls where indicated;
1. Reversible to allow lock to be located on either side of control.
2. Compatible with IR controls.
3. Does not reduce specified IR range by more than 50 percent of its original specification.
4. Product(s):
   a. 1-gang device for compatible Lutron QS keypads; Lutron Model GRX-1GLC.
   b. 4-gang device for Lutron Grafik Eye QS main units; Lutron Model QSG-4GLC.

2.13 SOURCE QUALITY CONTROL

A. See Section 01400 - Quality Requirements, for additional requirements.

B. Factory Testing; Lutron Standard Factory Testing:
1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
2. Perform full-function factory testing on 100 percent of all ballasts and LED drivers.
3. Perform factory audit burn-in of all dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for two hours.
4. Perform factory burn-in of 100 percent of all drivers at 104 degrees F (40 degrees C).
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as shown on the drawings.
B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
C. Verify that mounting surfaces are ready to receive system components.
D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those standards, including mounting heights specified in those standards unless otherwise indicated; or __________.
B. Install products in accordance with manufacturer's instructions.
C. Define each dimmer/relay load type, assign each load to a zone, and set control functions.
D. Sensor Locations:
   1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with Drawings.
   2. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.
E. Mount exterior daylight sensors to point due north with constant view of daylight.
F. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.
G. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
H. Lamp Lead Lengths: Do not exceed 3 feet (0.9 m) for T4 4-pin compact and T5 BIAx lamps and 7 feet (2.1 m) for T5, T5-HO, T8 U-bend, and T8 linear fluorescent lamps.
I. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).
J. System and Network Integration Consultation; Lutron LSC-INT-VISIT: Include as part of the base bid; as an alternate to the base bid; or __________ additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.
   1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.
K. Identify system components in accordance with Section 16195.
3.3 FIELD QUALITY CONTROL

A. See Section 01400 - Quality Requirements, for additional requirements.

B. Lutron Standard Startup Services:
   1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
   2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
   3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
      a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM – GENERAL REQUIREMENTS", authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
      b. Verify connection of power wiring and load circuits.
      c. Verify connection and location of controls.
      d. Address devices.
      e. Verify system operation control by control.
      f. Verify proper operation of manufacturer's interfacing equipment.
      g. Configure initial groupings of driver for wall controls, daylight sensors and occupancy sensors.
      h. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
      i. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
      j. Obtain sign-off on system functions.
      k. After Hours Startup; Lutron LSC-AH-SU: Include as an alternate to the base bid additional costs to perform manufacturer's startup procedures outside normal working hours (Monday through Friday, 7am to 5pm).

C. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.4 ADJUSTING

A. On-Site Scene and Level Tuning; Lutron LSC-AF-VISIT: Include as part of the base bid costs for Lighting Control Manufacturer to visit site to conduct meeting with Engineer and Owner's representative to make required lighting adjustments to the system for conformance with original design intent.

B. Sensor Fine-Tuning: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "LIGHTING CONTROL SYSTEM – GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits for fine-tuning of sensor calibration. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, Contractor to provide fine-tuning of sensor calibration.

3.5 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 COMMISSIONING
A. See Section 19113 – General Commissioning Requirements for commissioning requirements.

B. Title 24 Acceptance Testing Service; Not required.

3.7 CLOSEOUT ACTIVITIES

A. See Section 17800 - Closeout Submittals, for closeout submittals.

B. See Section 17900 - Demonstration and Training, for additional requirements.

C. Demonstration:
   1. On-Site Performance-Verification Walkthrough; Lutron LSC-WALK: Include as part of the base bid additional costs for lighting control manufacturer to provide on-site demonstration of system functionality to commissioning agent and/or facility representative.

D. Training:
   1. Include services of manufacturer's authorized Service Representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.
      a. Include training on software to be provided:
         1) Configuration software used to make system programming and configuration changes.
         2) Control and monitor.
         3) Energy savings display software.
         4) Personal web-based control software.

E. See Section 17000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION