WILLIAMS VILLAGE
PHASE 2A
Boulder, Colorado

PUMPHOUSE
(For Construction)

February 11, 2011

CU PROJECT NO. HSG 10334/PR003965

ALLER • LINGLE • MASSEY
ARCHITECTS
P.C.

MACKEY MITCHELL
ARCHITECTS

712 Whalers Way, Suite B-100
Fort Collins, CO  80525
(970) 223-1820
Project No. 0923
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DIVISION 2 - SITEWORK

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
PART 1   GENERAL

1.01  WORK INCLUDED

A. Excavating, backfilling, grading and compacting of site work related to building structures.
B. Prepare subgrade for building slabs, sidewalks and other improvements.
C. Shore and brace excavations as required.
D. Overexcavate existing native soils below new concrete foundation structures and/or slabs-on-grade, recondition, recompact and replace in overexcavated area.
E. Related work specified elsewhere:
   1. Division 1, Testing.
   2. Division 1, Construction Waste Management.
   3. Section 03300, Cast-in-Place Concrete.

1.02  QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
B. Soil Compaction Tests:
   1. ASTM D698 or AASHTO T99: Standard Method of Test for Moisture Density Relations of Soils Using a 5.5 lb. Rammer and a 12 inch drop.
      a. Use method A, B, C or D, as appropriate, based on soil condition and judgment of the testing laboratory.
      b. Sample tests will be representative of materials to be placed.
      c. Determine and provide optimum density curve for each type of material encountered or utilized.
      d. Include Atterberg Limits, grain size determination and specific gravity.
   2. ASTM D2049: Test for Relative Density of Cohesion less soils.
C. Test Certificates: Submit test certificates to enable Architect/Engineer to determine compliance with the Specifications for imported materials from each proposed source of supplier.
   1. Provide with this certificate a density test of a typical sample, in accordance with the following reference standards.
      a. ASTM D698 or AASHTO T99.
      b. ASTM D2049.

1.03  SITE CONDITIONS

A. Site Information: Data on subsurface conditions as described in the Soils Report is not intended as representation or warranty of accuracy or continuity between soil borings. Data is available for inspection at the CU Facilities Office. The Owner will not be responsible for interpretations or conclusions drawn therefrom.
B. The Contractor shall examine the site and the record of investigations and then determine for himself the character of materials to be encountered. Should subsurface conditions normally considered foreign to the locality or different than disclosed in test hole borings be encountered, the Contractor may be compensated for additional expenses resulting from such conditions.
C. Known underground and surface utility lines are indicated on the Civil Drawings.
D. Underground Obstructions:
   1. Underground obstructions known to Architect/Engineer are shown on Civil Drawings. However, locations shown may prove inaccurate and other obstructions not known to
Architect/Engineer may be encountered.

2. Notify each utility owner and request that utilities be field located by surface reference using flags at least 48 hours prior to trenching or excavation.

3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts may exist sufficiently in advance to permit changes in the event of conflict.
   b. In case of conflict the proposed Work may be changed by the Architect/Engineer.

4. Maintain, protect and support by shoring, bracing or other means existing utilities and appurtenances.

5. If Contractor elects to remove underground obstructions, the following conditions shall apply:
   a. Replace all other underground obstructions with new materials.
   b. Restore to original conditions or better.

6. Clean drainage culverts so they are free of sediment after construction.

E. Classification of Excavated Material: Excavated materials will not be classified. Excavation includes the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition or condition thereof. Refer to Section 02225, paragraph 3.01.A.

1.04 PROTECTION

A. Protect benchmarks and existing improvements to remain against damage from equipment and vehicular traffic.

B. Verify all utilities with appropriate authorities before proceeding with work, in accordance with requirements of Division 1. Protect all utilities which are to remain.

C. Protect excavations by shoring or bracing as required to maintain banks of excavation in safe and stable condition and to protect adjacent existing and new construction.

D. Provide suitable protection against bodily injury in accordance with applicable codes and governing authorities.

E. Protect bottom of excavations and soil around and beneath foundations from frost.

F. Notify Architect/Engineer of any unexpected subsurface conditions. Discontinue work in the area until Architect/Engineer provides notification to resume work.

1.05 INSPECTIONS AND TESTING

A. Notify the Architect/Engineer at completion of each phase of excavation prior to placement of formwork, concrete appurtenances or other materials. Also notify the Architect/Engineer prior to placement of backfill of all foundations. Notification shall be at least 48 hours prior to proceeding with the next phase of work.

B. Testing of compacted fill materials shall be performed by an independent testing laboratory submitted by the Contractor and approved by the Architect and Owner. Testing fees shall be paid in accordance with the General and Supplementary Conditions.
   1. The Contractor will pay for costs of additional testing required due to improper performance of the work.

C. Soils Engineer shall make an open-hole inspection of the excavation for each building prior to the placement of formwork, concrete appurtenances or other materials. Soils Engineer shall also inspect structural backfill for building foundations prior to forming of footings, if not supported on undisturbed soil.

D. When work of this Section or portions of work are completed, notify the testing laboratory to perform density test. Do not proceed with additional portions of work until results have been verified.

E. Compaction Tests:
   1. Concrete Flatwork: Tests of compacted backfill materials shall be taken at the rate of one
(1) test for each 5,000 sq. ft., or portion thereof, of surface area for interior or exterior concrete slabs-on-grade, sidewalks, aprons, or other flatwork, unless otherwise modified by the Soils Report.

2. Foundation Walls: Tests of compacted backfill materials shall be taken at the rate of one (1) test for each 30 lin. ft., or portion thereof, of building perimeter for compaction adjacent to building foundation walls, unless otherwise modified by the Soils Report.

F. If tests indicate that compacted materials do not meet specified requirements, remove defective work, replace and retest at no additional cost to the Owner.

1.06 WARRANTIES

A. Maintain and repair backfill, fill compaction and embankment settlement and make necessary repairs to pavement, sidewalks or other structures which may be damaged as a result of settlement for a period of one (1) year after Substantial Completion and acceptance of the work.

PART 2  PRODUCTS

2.01 SELECTED FILL MATERIALS

A. General: Use onsite or imported soil approved by the Soils Engineer for rough fill and for backfill against the outside of foundation walls except as specified below. Material shall be clean, compactable earth, free of frozen material, debris, deleterious or organic substances or large rocks.

B. Structural Fill: On-site natural soils, devoid of debris or imported granular materials approved by the Soils Engineer, mechanically compacted as specified below and extended to original undisturbed soil. Use under floor slabs and exterior concrete where approved on-site material is available or where shown on the Drawings.

1. Material shall be uniformly graded of low permeability and a swell potential of less than 1%.

C. Imported Structural Fill: Where onsite material is expansive or otherwise unacceptable to the Soils Engineer for use as structural backfill, imported fill shall be Class 1 structural backfill or Class 7 roadbase, conforming to Colorado Department of Transportation standards.

D. Coarse Granular Fill: Clean, crushed, non-porous rock, crushed or uncrushed gravel graded from 3/8" to 1-1/2".

E. Fine Granular Fill: Natural or manufactured sand and pea gravel, clean and free of organic debris graded from 3/8" to No. 100 sieve.

F. Topsoil: Refer to landscaping sections of Division 2. Topsoil stripped and stockpiled on-site may be used if it meets the requirements of these Sections. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of subsoil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth.

G. Unsuitable Materials: All material removed in stripping and all material containing perishable matter such as roots, sod, grass, decayed vegetable matter, debris or materials having unsatisfactory compaction characteristics shall be classified as unsuitable for use in the work. All excavation of unsuitable material shall be removed from the site and disposed of by the Contractor.

1. Materials which are temporarily unusable due to excessive moisture or improper gradation will not be classified as unsuitable unless such material cannot be satisfactorily reclaimed by screening, manipulation, aerating or blending with other materials as determined by the Soils Engineer.
2.02 ACCESSORY MATERIALS

A. Drainage Fabric: Mirafi 140 N filter fabric or equal.
B. Silt Fence (Erosion Control): Woven filter fabric, type and size as required by the City of Boulder and/or the State of Colorado.

PART 3 EXECUTION

3.01 PREPARATION

A. Site preparation and compaction of existing and/or imported fill materials shall be in accordance with the requirements of the Soils Investigation Report and this Section. If the foundation structure design shown on the Drawings and/or specified will not strictly conform to this requirement, advise Architect/Engineer before proceeding with work of this Section.

B. Clear and strip surface vegetation, sod and organic topsoil for subgrades for areas within construction boundaries as shown on the Drawings or directed by the Architect/Engineer. The stripped topsoil shall be stored for later use in the site finish grading.

1. Extent of Stripping: As required for new construction, as shown on the Drawings, or as directed by the Architect/Engineer. Topsoil shall not be stripped or existing vegetative cover disturbed in excess of these limits without written approval of the Architect/Engineer.

C. Contractor shall take all necessary safety precautions to ensure the safety of all workers and the public in and around excavations, including shoring, bracing and barricades.

D. Brace and properly support all structural elements, including foundation walls, prior to beginning and continuously during backfilling and compacting operations.

E. Soils Engineer: The Soils Engineer shall inspect the natural soil at the bottom of excavations for structures, prior to forming or placing foundations. Provide Engineer with 48 hours notice (exclusive of weekends and holidays) when the areas are expected to be ready for such inspections.

1. Do not prepare subgrade or place concrete until such inspection has taken place (or waived by Engineer) and resulting recommendations of Engineer have been carried out.

3.02 ROUGH GRADING

A. Rough grade site to required levels, profiles, contours and elevations ready for finish grading and surface treatment. Maintain the following:

1. Planting Areas: 6" below finished grade elevation.
2. Concrete Sidewalks: 4" below finished grade elevation, unless granular backfill is specified below walks.
3. Building Slabs: 8" minimum below finished slab elevation, or as required by the Soils Report for the slab thickness and thickness of granular backfill specified.

B. Prior to placing fill material over undisturbed subsoil, scarify surface to depth of 6", bring to 2% optimum moisture and compact as follows:

1. Adjacent to Building Foundations: Minimum 95% of Standard Proctor Density at 2% wet of optimum moisture content ASTM D698-78.
2. Pavement Areas: 95% of SPD at 2% wet of OMC, ASTM D698-78.
3. Planting Areas: 90% of SPD at 2% wet of OMC, ASTM D698-78.

C. Place fill in lifts of 6" to 8" maximum loose layers, bring to 2% wet of OMC and compact each layer as specified above.

D. Stockpile existing topsoil and fill materials removed from excavation for reuse in final grading.

E. Contractor shall take special care in rough grading and filling of site areas which can lead to non-uniform settling and compaction.
3.03 EXCAVATION

A. General:
   1. Excavation consists of removal and disposal of material encountered when establishing grade elevations.
   2. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Architect/Engineer. Unauthorized excavation, as well as remedial work directed by the Architect/Engineer, shall be at the Contractor’s expense.

B. Blasting: No blasting will be permitted as a part this Project without written authorization from the Owner's principal representative.

C. Stability of Excavation:
   1. Slope sides of excavations to comply with local codes and ordinances. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
   2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
   3. Verify that bottom of excavation for footings and foundations is on original undisturbed soil. If it is not, overexcavate and fill with approved structural fill material extending from original undisturbed soil to bottom of footings and foundations, compacting as specified in paragraph 3.06.

D. Material Storage:
   1. Stockpile satisfactory excavated materials and topsoil until required for backfilling. Place, grade and shape stockpiles for proper drainage.
   2. Locate and retain soil materials away from edge of excavations.
   3. Stockpile materials away from sidewalks, streets, alleys and other public areas that are to remain accessible during construction. Maintain site access as required for workers and the Owner.
   4. Dispose of excess soil materials and waste materials.

3.04 EXCAVATION FOR STRUCTURES

A. General: Conform to elevations and dimensions shown within a tolerance of +/- 0.10' and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and inspection.

B. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete.

C. Verify that bottom of excavation for footings and foundations is on original undisturbed soil. If it is not, overexcavate and fill with approved structural fill material extending from original undisturbed soil to bottom of footings and foundations, compacting as specified.

D. Do not interfere with normal 45° bearing splay of any foundation.

E. Under building slabs, remove minimum 8” of existing material below finished slab elevation. Refer to paragraph 3.05 below for overexcavation of soils below slabs-on-grade.

3.05 BACKFILLING

A. Do not start utility backfilling until services and dampproofing systems have been inspected.

B. Ensure areas to be backfilled are free from debris, snow, ice and water and that ground surfaces are not in a frozen condition.

C. Do not backfill over existing subgrade surfaces which are porous, wet or spongy.

D. Compact existing subgrade surfaces if densities are not equal to that required for backfill materials.

E. Remove soft areas of existing subgrade, backfill with subsoil and compact to required density.

F. Backfill areas to grades, contours, levels and elevations. Backfill systematically and as early as possible.
possible to allow maximum time for natural settlement and compaction.

G. Place and compact fill materials in continuous layers not exceeding 8" loose depth. Use a method so as not to disturb or damage building drainage system.

H. Where temporary unbalanced pressures are liable to develop on walls before floor slabs are placed, erect necessary shoring to counteract imbalance and leave in place until their removal is approved by Architect/Engineer.

E. Maintain 2% wet of OMC of backfill materials to attain required compaction density.

F. Backfill simultaneously on each side of foundation walls to equalize soil pressures.

G. Utility Trench Backfill: Refer to Civil Drawings.

H. Building Slab Backfill: Verify removal of existing material below slabs-on-grade, as specified in paragraph 3.02 above.

3.06 FILL TYPES AND COMPACTION

A. Structural Backfill below Footings and Foundations: On-site natural soils, devoid of debris, or imported, non-expansive granular materials approved by Soils Engineer, mechanically compacted to a minimum of 98% of SPD.

B. Building Slabs: On-site natural soils or select granular non-expansive materials approved by the Soils Engineer to underside of stabilizing base course, mechanically compacted to a minimum of 95% of SPD.

C. Backfill Around Structures: Mechanically compact to a minimum of 95% of SPD.

D. Sidewalks: Subsoil or approved fill to underside of stabilizing base course. Compact each layer of fill material at 2% wet of OMC to a minimum 95% of SPD per ASTM D698-78.

E. Lawn and Landscaped Areas: Subsoil to top of subgrade elevation, compacted to 90% of SPD.

F. Compaction Equipment: Use compaction equipment suitable for the types of soils and materials being compacted.
   1. Sheepfoot Roller: If used provide with cleaner bars attached as to prevent the accumulation of materials between the tamper feet.
   2. Rollers: Use rollers so designed that the effective weight can be increased as required to obtain specified compaction.
   3. Vibrating plate compactors.

G. Ponding or flooding is not allowed for any compaction.

3.07 FINISH GRADING

A. Rough grade subsoil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. in excess of 3" in size. Remove subsoil which has been contaminated with petroleum products.

B. Bring subsoil to required levels, profiles and contours. Make changes in grade gradually and blend slopes into existing areas. Maintain tolerance within .10' of required subgrade, except under building slabs where final grades shall be within 1/2" of required elevation.

C. Slope finish grade away from building minimum 5% for the first 10', unless indicated otherwise on the Drawings.

D. Scarify subgrade to a depth of 6" where topsoil is to be placed and compact as specified. Provide depth allowances for topsoil placement.

E. Place and shape subgrade for landscape berms and other artificially created earthen features as shown on the Drawings.

3.08 PLACING TOPSOIL

A. General: Spreading of topsoil shall be the responsibility of this Section, unless arranged for otherwise.

B. Place and spread topsoil with minimum depth of 6", using suitable stockpiled, on-site material, supplemented with imported material as required.
C. Use topsoil in relatively dry state. Place during dry weather.

D. Fine grade topsoil to within 1" of finish contours unless otherwise required for areas receiving sod, mulch or other landscape treatment, eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of subgrades to tie new work into existing.

E. Remove stones, roots, grass, weeds, debris and other foreign materials while spreading.

F. Manually spread topsoil around trees, plants and buildings to prevent compaction and damage which may be caused by grading equipment.

G. Do not change elevation of finish grade around existing trees to remain more than 6" without specific approval of the Architect.

H. Lightly compact placed topsoil and leave prepared for soil preparation and landscaping specified in other Sections of Division 2.

3.09 FIELD QUALITY CONTROL

A. Field Compaction Control: Field tests shall be conducted to determine compliance of compaction methods with specified density in accordance with:
   1. ASTM D2922 (AASHTO T238): Tests for Density of Soil and Soil - Aggregate In-Place by Nuclear Methods, or,
   2. ASTM D1556 (AASHTO T191): Tests for Density of Soil In-Place by the Sand Cone Method.
   3. ASTM D2167 (AASHTO T205): Tests for Density of Soil In-Place by Rubber-Balloon Method.

B. Compaction shall be to the minimum densities specified in paragraph 3.06 above.

C. Moisture Content: Compact soils within +/- 2% of optimum moisture. Add water, harrow, disc, blade or otherwise work material as required to insure uniform moisture content and adequate protection.

3.10 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settled, eroded and rutted areas to specified tolerances until Substantial Completion and acceptance of the work of this Section by the Owner.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, or where topsoil has been compacted in excess of the specified limits, scarify surface, reshape and compact to required density prior to further construction.

3.11 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Excess Fill: Remove and dispose of debris and excess materials off of Owner’s property.

END OF SECTION
DIVISION 3 - CONCRETE

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 03100
CONCRETE FORMWORK

PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish labor, materials and equipment necessary for the complete construction of required formwork for cast-in-place concrete.
B. Furnish and install anchors and other accessories required to be cast into concrete work.
C. Furnish materials and equipment necessary to strip and remove formwork.
D. Install embedded items furnished by other Sections.
E. Related work specified elsewhere:
   1. Section 01015, LEED Requirements.
   2. Section 03300, Cast-in-Place Concrete.

1.02  RELATED WORK FURNISHED BY OTHERS

A. Embedded plates for structural steel attachment shall be furnished by the steel fabricator and installed by the Contractor.

1.03  QUALITY ASSURANCE

A. General: Conform to the requirements and recommendations of ACI 301, “Specification for Structural Concrete in Buildings”, and ACI 347, “Recommended Practice for Concrete Formwork”, unless otherwise shown.
   1. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Contractor shall be responsible for the design and engineering, construction and maintenance of formwork, as well as its adequacy and safety.
C. Contractor shall design formwork for all loads and lateral pressures before and during placement of concrete. Maintain position and shape of formwork at all times. Provide positive means of adjustment for shores and forms which rest on compressible material.
D. LEED Compliance: Refer to Section 01015 for submittal and documentation requirements for Credits MR 4.1, 4.2, 5.1 and 5.2.

1.04  SUBMITTALS

A. LEED Submittals:
   1. Credit MR 4.1 and MR 4.2: Product Data indicating percentages by weight of postconsumer and preconsumer recycled content for accessory materials.
      a. Include statement that indicates costs for each product having recycled content.

PART 2  PRODUCTS

2.01  FORMWORK FOR EXPOSED CONCRETE

A. Construct all formwork for exposed concrete surfaces with metal-framed/plywood-faced, metal or plastic panel-type materials to provide continuous, straight, smooth, solid exposed surfaces. Furnish in largest practicable sizes to minimize number of joints. Do not use any forms having defects on contact surfaces.
1. Plywood forms will only be acceptable upon specific approval of the Architect, and then only after visual inspection on the job site.
2. Plywood shall be sufficiently thick to withstand pressure of wet concrete without bow or deflection but shall not be less than 5/8" thick, complying with U.S. Product Standard PS-1, “B-B High Density Overlaid Concrete Form, Class 1”, or “B-B Exterior Type DFPA Plyform, Class 1”.

B. Chamfer exposed external corners and edges, using chamfer strips accurately fabricated to produce uniform smooth lines and tight-edge joints.
C. Refer to the Drawings for locations where special joints may be required.
D. Arrangement for sheets or liner sheets shall be orderly and symmetrical. Form ties shall be spaced uniformly and aligned horizontally and vertically where locations are exposed to view in the completed project.

2.02 FORMWORK FOR UNEXPOSED CONCRETE

A. Form concrete which will be unexposed in finished structure with plywood, boards, metal or other acceptable material. Provide lumber that is dressed on at least two (2) edges and one (1) side for a tight fit.
B. Earthen or trenched forms shall not be used for vertical formwork.

2.03 ACCESSORY MATERIALS

A. Premolded Joint Fillers: In joints caulked or sealed with silicone or thiokol-based compound, filler shall be non-bituminous, non-extruding, conforming to ASTM D1752. In all other joints, filler shall be bituminous type conforming to ASTM D1751. Filler shall be 1/2" thick, unless otherwise indicated.
   1. Non-Bituminous Filler: Sonoflex F by Sonneborne or equal.
B. Premolded Fiberboard Joint Fillers (Bituminous-Type): Preformed rigid cane fiberboard material, impregnated with a durable asphaltic compound, conforming to AASHTO-M213. Fillers shall be 1/2" thick, unless otherwise indicated.
   1. Bituminous Filler: Flexcell by Celotex or approved equal.
C. Bond Breaker: Where shown on the Drawings or required by the work, provide minimum two (2) layers 15-lb. non-bituminous felt bond breaker.
D. Column Isolation Joints: Joints around columns may be formed with minimum 30# non-bituminous building felt left in place with neatly trimmed top edge or approved joint filler material.
E. Keyways: Provide nominal 1-1/2” deep keyways in all construction joints in walls, slabs and joints between walls and slabs, unless otherwise shown.
F. Form Ties: Provide factory-fabricated break-back, removable, or snap-type form ties designed to prevent spalling concrete surfaces on removal and which will leave no metal within 1" of concrete surface. Use stainless steel, plastic-coated or hot-dipped galvanized at exposed concrete with cone-shaped tie heads, manufactured by Dayton, Gates, Heckman, Richmond or approved equal.
G. Release Agent: Provide commercial formulated synthetic resin or oil-type form coating compounds that will not bond with or adversely affect concrete surfaces and will not impair subsequent finish treatment of surfaces, manufactured by Protex Pro-Coat, Euclid Eucoslip, J & P Tex-Mastic or approved equal.
   1. Contractor shall ensure that release agent is compatible with the finish requirements of concrete to be exposed to view.
H. Embedded Plates, Sleeves and Anchor Bolts: Miscellaneous embedded items furnished by other Sections. Refer to the appropriate Section(s) in these Specifications.
PART 3  EXECUTION

3.01 PREPARATION

A. Site preparation and compaction of existing and/or imported fill materials shall be in accordance with the requirements of the Soils Investigation Report. If the foundation/SOG structure design shown on the Drawings and/or specified will not strictly conform to this requirement, advise Architect/Engineer before proceeding with work of this Section.

B. Expansion, Construction and Other Joints: Properly lay out work and make necessary preparations for construction of specified joints in cast-in-place concrete work.
   1. Take special care to provide joints to allow for removal of sections of concrete foundations, walls or flatwork for future construction where shown on the Drawings.

C. Ensure that connector plates, sleeves, dovetail anchor slots and other concrete accessories embedded in concrete are properly located, aligned and secured prior to placing concrete.

3.02 FABRICATION

A. Construct forms complying with ACI 347 to the exact sizes, shapes, lines and dimensions as shown on the Drawings and as required to obtain accurate alignment, location, grades, level and plumb work in finished structures. Use selected material to obtain the required finishes. Concrete tolerances shall be as specified in Section 03300.

B. Construct formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

C. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt all joints and provide backup materials at joints as may be required to prevent leakage. Ensure that formwork is properly braced and tied.

D. Provide openings in forms as required to accommodate other work. Accurately place and securely support all items required to be built into the forms. Size and locations of openings, recesses, chases and other built-in items shall be obtained from the Contractor or the trades involved.

3.03 PREPARATION OF FORM SURFACES

A. Prior to each use, coat contact surfaces of forms with release agent prior to placement of reinforcement, in accordance with the manufacturer's recommendations. Do not allow excess coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed.

B. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Refer to Section 03300 for required concrete finishes.

C. Ensure that all debris and frost has been removed from forms before placing concrete.

D. Clean, repair and recoat surfaces of forms that are to be reused. Split, frayed, delaminated or otherwise damaged form facing materials will not be acceptable.

E. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and tighten forms to close all joints. Align and secure all joints to avoid offsets.

3.04 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.

B. Install embedded plates and anchor bolts, accurately located, to elevations required.

C. Tolerances on embedded items: Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC’s “Code of Standard Practice for Steel Buildings and Bridges 2000” and with the following additional requirements:
   a. Tolerance of embedded items: Comply with ACI 117 and the following additional
requirements:
1) Anchor rods: Plumbness within +1/16” over the projecting height of the anchor bolt.
2) Embedded Plates and Weldment: Location within +/-1” vertical, +/-1” horizontal. Plumb and alignment: ¼” in 12”.

3.06 REMOVAL OF FORMWORK

A. Formwork not supporting weight of concrete such as sides of grade beams, walls and similar parts of work may be removed 48 hours after placing concrete, providing concrete is sufficiently hard to not be damaged by removal operations and providing that curing and protection operations are maintained. Refer to specific requirements for hot- and cold-weather concreting in Section 03300.

B. Whenever formwork is removed during the curing period, cure exposed concrete as specified in Section 03300.

C. Contractor shall verify required tolerances specified in Section 03300 immediately after removal of forms.

D. Carefully remove fins or other minor surface defects from concrete to remain exposed in the final construction, and leave surfaces prepared for sealers, paint, skim coats or other finishes. Repair minor imperfections as specified in Section 03300.

END OF SECTION
SECTION 03200

CONCRETE REINFORCING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish, bend and install all reinforcing bars, welded wire fabric, ties and supports.
B. Related work specified elsewhere:
   1. Section 01015, LEED Requirements.
   2. Section 01714, Construction Waste Management.
   3. Section 03100, Concrete Formwork.
   4. Section 03300, Cast-in-Place Concrete.

1.02 QUALITY ASSURANCE

B. Contractor Quality Assurance Program: Refer to Section 03300 for requirements.
C. Reference Standards: Comply with requirements of the following codes and standards, except as otherwise shown or specified:
   1. ACI 318, "ACI Standard Building Code Requirements for Reinforced Concrete".
   2. ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
   3. ACI 301-99, "Specifications for Structural Concrete for Buildings".
   4. CRSI "Manual of Standard Practice".
   5. CRSI "Recommended Practice for Placing Reinforcing Bars".
   6. CRSI "Recommended Practice for Placing Bar Supports".
   7. AWS D12.1, "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction".
   8. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
D. Contractor shall obtain specific approval from the Architect/Engineer for the following items:
   1. Relocation of bars to an extent that causes placement tolerances to be violated.
   2. Bar chairs and spacers.
   3. Splices not shown on the Drawings and mechanical connectors.
E. LEED Compliance: Refer to Section 01015 for submittal and documentation requirements for Credits MR 4.1, 4.2, 5.1 and 5.2.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings for all reinforcing steel, indicating bending and cutting, preformed corners and intersections. Comply with ACI 315 showing bar schedules, stirrup or tie spacing, diagrams of bent bars, arrangement and assemblies as required for the fabrication and placement of concrete reinforcement. Include all special reinforcement required and openings through concrete structures. Show wall and grade beam reinforcement on elevations drawn at a scale of not less than 1/4" = 1'-0".
B. Certificates: Furnish, prior to fabrication, certified mill test reports covering physical and chemical tests of reinforcing steel.
C. LEED Submittals:
   1. Credit MR 4.1 and MR 4.2: Product Data indicating percentages by weight of postconsumer and preconsumer recycled content for reinforcing steel.
a. Include statement that indicates costs for each product having recycled content.

2. Material Source (MRc5):
   a. Submit product data or other published information verifying the location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer’s documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc. and the distance between this location and the project site. Also include material costs (excluding costs of installation).
   b. Include information on Material Tracking Worksheets.

1.04 INSPECTION AND TESTING

A. Notify the Owner’s testing and inspection agency at least 48 hours in advance of closing of forms and/or placing concrete so that inspection of reinforcement in place can be made. Do not cover any reinforcement with formwork or concrete until reinforcement has been checked and approval given to proceed with formwork and/or concreting operations.

B. Testing of reinforcing welds and splices will be as specified in Section 01410.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver reinforcement to site in strongly tied bundles with metal tags corresponding to bar schedules and diagrams. Store on the site free of rust, scale, oil or other coating. Store bars off the ground and protect from moisture, dirt, oil or deleterious coatings.

B. If concreting is delayed for any considerable period of time after reinforcement is in place, it shall be protected by suitable covering.

C. Protect exposed reinforcement intended for bonding with future extensions by suitable covering, if applicable.

PART 2 PRODUCTS

2.01 REINFORCING MATERIALS

A. Bars: ASTM A615, 60 KSI grade, deformed billet steel bars, plain finish, as indicated on the Drawings. Bars shall be free of scale or other bond-reducing coatings.

B. Low alloy steel: ASTM A706, grade 60.

C. Welded Wire Fabric: ASTM A185 or A497, plain type in flat sheets, plain finish, welded intersections, in sizes as indicated on the Drawings.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

E. Field Bent Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M, Grade 60, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

F. LEED Design Criteria:
   1. Credits MR 4.1 and 4.2, Recycled Content: 25% minimum post-consumer; 90% total.
   2. Credit MR 5.1, Local/Regional Materials, Manufactured Locally: Required. Contractor to provide information on locally manufactured products, in compliance with Section 01015.
   3. Credit MR 5.2, Local/Regional Materials, Harvested Locally: Contractor to provide information on locally extracted, harvested or recovered materials, in compliance with Section 01015.
   4. Regional Material Source (MRc5): Building materials in this section must be extracted, harvested, or recovered, and manufactured and assembled within five hundred (500) miles of the jobsite.
2.02 ACCESSORY MATERIALS

A. Accessories shall be of suitable type conforming to ACI 315 and shall include spacers, chairs, tie bars, support bars and all other devices for properly assembling, placing and supporting reinforcement, weight of concrete and workmen without displacement of reinforcement. Wood, brick, block, concrete chips and other non-metallic devices are not acceptable.

B. For concrete slab-on-grade use supports with sand plates or horizontal runners where wetted base materials will not support chair legs. Concrete briquettes for support of reinforcement for slabs-on-grade shall be at least 2“ wide x 3” long and of proper height.

C. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs which are hot-dipped galvanized, plastic protected or stainless steel protected.

D. Wire Ties: Wire for tying shall be annealed, cold-drawn wire of at least 16-gage.

2.03 FABRICATION

A. Shop fabricate reinforcing bars to conform to the required shapes and dimensions with fabrication tolerance complying with ACI 315. Cold bend bars in a manner which will not injure material.

B. Straightening, bending or rebending at site will not be permitted unless bars are made from a low alloy steel.

C. Where reinforcing bars are shown welded to structural steel, bars are to be furnished by rebar supplier and welded in place by structural steel erector.

PART 3 EXECUTION

3.01 PREPARATION

A. Site preparation and compaction of existing and/or imported fill materials shall be in accordance with the requirements of the Soils Investigation Report and Section 02225. If the foundation/SOG structure design shown on the Drawings and/or specified will not strictly conform to this requirement, advise Architect/Engineer before proceeding with work of this Section.

B. Construction Waste Management and Disposal:
   1. Manage construction waste in accordance with provisions of Section 01524.

3.02 SPLICES

A. Splices not shown on the Drawings must be approved by the Architect/Engineer.

B. Lapped splices shall be securely wired together. Minimum laps shall be in accordance with requirements shown on the Drawings. Offset vertical lap splices at least one bar diameter.

3.03 PLACING REINFORCING STEEL

A. Prior to placing into position, thoroughly clean reinforcement of mill scale and excessive rust, dust, mud, oil, ice and all other deleterious coating which may destroy or reduce bond.

B. All reinforcing shall be placed in accordance with the Drawings and the “Manual of Standard Practice for Detailing Reinforced Concrete Structures”, ACI 315, ACI 301 and ACI 318.

C. Accurately place and support reinforcing steel with chairs, bar supports, spacers or hangers as recommended by ACI detailing manual except in slab-on-grade work. Support bars in slabs-on-grade and footings with approved accessories.

D. Place reinforcing bars to a tolerance of +/- 1/4". Bars may be moved as necessary to avoid interference with other reinforcing steel, conduit or embedded items. The Architect/Engineer’s approval must be obtained prior to moving bars under these circumstances.

E. Securely anchor and tie reinforcing bars and dowels prior to placing concrete.

F. Place reinforcement to obtain at least the minimum coverage for concrete protection shown on the
Drawings and specified. Do not place reinforcement with additional concrete cover unless expressly approved by the Structural Engineer.

G. Install dowels before any concrete is placed. Locate column dowels accurately with aid of template before concrete starts to set.

H. Steel reinforcing bars shall run continuous through cold joints.

I. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

PART 4 SCHEDULES

4.01 SCHEDULE OF REINFORCING MATERIALS

A. Reinforcing materials shall be placed in quantities, sizes and spacing as shown on the Drawings and/or as scheduled herein:
   1. Reinforcing bars shall be installed where shown or scheduled on the Drawings.
   2. Fiber reinforcing shall be placed in all poured-in-place concrete flatwork, including exterior concrete drives, apron pavements and curb and gutter sections, sidewalks, etc., regardless of whether these already are reinforced with steel or wire materials.
   3. Fiber reinforcing is not required in footings, foundation walls and grade beams.

END OF SECTION
SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install cast-in-place concrete at foundation elements including footings, grade beams and slab on grade.
B. Finishing and application of integral surfacing as scheduled, curing and sealing of slabs.
C. Furnishing and placing joint materials.
D. Furnish and install cast-in concrete accessories, unless arranged for otherwise.
E. Apply cementitious smoothing and resurfacing coating for vertical surfaces where specified and/or indicated on the Drawings.
F. Related work specified elsewhere:
   1. Section 01015, LEED Requirements.
   2. Section 01410, Testing.
   4. Section 01410, Testing.
   5. Section 03100, Concrete Formwork.
   6. Section 03200, Concrete Reinforcement.
   7. Section 07900, Sealants and Joint Fillers.
   8. Division 15, Mechanical.

1.02 QUALITY ASSURANCE

A. Reference Standards: Except as modified or supplemented in these Specifications, structural concrete shall meet the requirements of the following standards. Refer to the standards for detailed requirements.
   1. ACI 318, "Building Code Requirements for Reinforcing Concrete".
   2. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
   3. ACI 305, "Recommended Practice for Hot Weather Concreting".
   4. ACI 306, "Recommended Practice for Cold Weather Concreting".
   6. ASTM C33, "Standard Specification for Concrete Aggregates".
   10. ASTM C618, "Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete".
   12. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

B. Contractor Quality Assurance Program: Contractor shall have in place a quality assurance program to monitor the composition of the ready-mixed concrete provided for this project. The quality assurance program shall detail:
   1. Quality and types of aggregates, cement, mineral admixtures, chemical admixtures and water.
   2. Batching of these materials, including properties of the batched mix(es).
   3. Delivery and placement requirements for the batched mix(es).
4. Regular contractor monitoring and testing of batched materials.

C. Contractor shall maintain a copy of ACI SP-15-72, "Field Reference Manual" in the field office at all times.

D. Contractor shall employ an experienced and competent foreman for all concrete work. The foreman shall be thoroughly familiar with all phases of concrete construction, including formwork. Upon request submit records of qualifications and experience of the foreman to the Architect.

E. All concrete work which does not conform to specified requirements, including strength, tolerances and finishes, shall be corrected or removed and replaced as directed by the Architect/Engineer, at the Contractor's expense. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from correction to concrete work and for any additional testing of work in place which may be required.

F. LEED Compliance: Refer to Section 01015 for submittal and documentation requirements for Credits MR 4.1, 4.2, 5.1 and 5.2.

1.03 SUBMITTALS

A. Mix Design: Submit proposed mix design(s) in accordance with ACI 304 for approval by the Architect/Engineer. Submit written design mix reports for each class of concrete at least fifteen (15) days prior to start of work. Include the following in each report:
1. Project identification.
2. Concrete class.
5. Cement type and brand.
6. Manufacturer and brand name of admixtures.
7. Proportions of concrete mixed per cubic yard.
8. Test results for each property specified for design mix.
9. Unit weight.

B. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, color additives and concrete stains, sealers, hardener and finishing compounds.

C. Contractor Quality Assurance Program: Submit for review by the Architect/Engineer in accordance with paragraph 1.02.B.

D. Certificates:
1. Sieve analysis of fine and coarse aggregates.
2. Certification of appropriate use for hardening and sealing products, as specified in paragraph 2.07.

E. Contractor shall retain for Architect/Engineer’s review, if requested, all delivery tickets for each load delivered to the site. Tickets shall show truck number, concrete strength, cement brand and type, cement content, water content (also expressed as water/cement ratio), amount of coarse aggregate and fine aggregate, name and amount of admixture, number of yards delivered, time of arrival at site and mixing time.

F. LEED Submittals:
1. Credit EQ 4.1: Product Data for adhesives and sealants, including printed statement of VOC content.
2. Credit EQ 4.2: Manufacturer's product data for paints and stains, including printed statement of VOC content and chemical components.
3. Credit EQ 4.4:
   a. Composite wood manufacturer's product data for each composite wood product used indicating that bonding agent used contains no urea formaldehyde.
   b. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.
4. Credit MR 4.1 and MR 4.2: Product Data indicating percentages by weight of postconsumer

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and preconsumer recycled content for products having recycled content.

a. Include statement that indicates costs for each product having recycled content.

5. (Credit MR7: Certificates of chain-of-custody signed by manufacturers certifying that products specified to be made from certified wood were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, “Principles and Criteria”. Include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.)

6. Recycled Content (MRc4):
   a. Submit product data or other published information indicating total weight of product to be provided for the Project, percent of post-consumer recycled material by weight and percent of post-industrial recycled material by weight. Include material costs (excluding costs of installation).
   b. Include information on Material Tracking Worksheets.

7. Material Source (MRc5):
   a. Submit product data or other published information verifying the location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer’s documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc. and the distance between this location and the project site. Also include material costs (excluding costs of installation).
   b. Include information on Material Tracking Worksheets.

1.04 INSPECTION

A. Provide free access for the inspection agency to locations where concrete materials are stored, proportioned or mixed. Do not place concrete until forming and reinforcing for a given pour has been approved by the inspection agency.

B. Provide minimum 24 hours advance notice for inspection to the inspection agency, but ensure that forming and reinforcing are substantially complete at the time of notification.

1.05 TESTING

A. Inspection and testing of concrete mix will be performed by an independent testing agent approved by the Architect. Testing fees shall be paid as specified in the General and Supplementary Conditions, or as modified by an amendment to the Contract.

B. Provide free access to work and cooperate with the appointed firm.

C. Submit proposed concrete mix design to the inspection and testing firm for review prior to commencement of work.

D. Field Quality Control Testing: Perform sampling and testing for field quality control during the placement of concrete, as follows:
   1. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
   2. Slump: ASTM C143; one (1) test for each set of compressive strength test specimens.
   3. Air Content: ASTM C231, pressure method, one (1) test each set of compressive test specimens, or when the indication of change requires.
   4. Compression Test Specimens: ASTM C31; one (1) set of four (4) standard cylinders for each compressive strength test, unless otherwise directed.
   5. Cast and store cylinders for laboratory cured test specimens and field-cured test specimens as specified in ASTM C31.

E. Compressive Strength Tests:
   1. ASTM C39: One (1) set for each 50 cu. yds. or fraction thereof of each mix design placed in any one day, or for each 5,000 sq. ft. of surface area placed; one (1) specimen tested at seven (7) days, two (2) specimens tested at 28 days, and one (1) specimen retained in reserve for later testing if required.
2. When the frequency of testing will provide less than three (3) strength tests for a given mix
design, conduct testing from at least five (5) randomly selected batches or from each
batch if fewer than three (3) are used.
3. Report test results in writing to the Owner, Architect, Structural Engineer, Contractor and
ready-mix supplier on the same day that tests are made. Reports of compressive strength
tests shall contain the project identification name and number, date of concrete
placement, the name of contractor, name of the concrete supplier and truck number,
name of the concrete testing service, concrete type and class, location of concrete batch
in the structure, design compressive strength at 28 days, concrete mix proportions and
materials, compressive breaking strength and type of break for both 7-day tests and 28-day
tests.
4. The testing agency will make additional tests of in-place concrete when test results
indicate the specified concrete strengths and characteristics have not been attained in the
structure, as directed by the Architect/Engineer. The testing agency shall conduct tests to
determine the strength and other characteristics of the in-place concrete by compression
tests on cored cylinders complying with ASTM C42, by load testing specified in ACI 318 or
other acceptable non-destructive testing methods, as directed. The Contractor shall pay
for this additional testing.
F. Slump Test: One (1) slump test will be taken for each set of test cylinders taken.
G. Air Entrainment Test: One (1) air entrainment test will be taken for each set of test cylinders
taken.
H. Test hourly when air temperature is 40° F and below, and when 80° F and above and each time a
set of compression test specimens are made.

1.06 EVALUATION OF QUALITY CONTROL TESTING
A. Do not use concrete delivered to the final point of placement which has slump or total air content
outside the specified values.
B. Compressive strength tests for laboratory-cured cylinders will be considered satisfactory if the
averages of all sets of three (3) consecutive compressive strength tests results equal or exceed the
28-day design compressive strength of the type or class of concrete and no individual strength test
falls below the required compressive strength by more than 500 psi.
C. If the compressive strength tests fail to meet the minimum requirements specified, the concrete
represented by such tests will be considered deficient in strength and subject to additional testing
as herein specified or removal and replacement of the concrete which the test represents.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING
A. Store cement in watertight enclosures and protect against dampness, contamination and warehouse
set.
B. Stockpile aggregates to prevent excessive segregation or contamination with other materials or
other sizes of aggregates. Use only one (1) supply source for each aggregate stockpile.
C. Store admixtures to prevent contamination, evaporation or damage. Protect liquid admixtures
from freezing or harmful temperature ranges.
D. Allow a maximum of 90 minutes between the time water is added and the time the concrete is
completely placed.

1.08 ENVIRONMENTAL CONDITIONS
A. Environmental Requirements:
   1. Do not place concrete during rain, sleet or snow, unless adequate protection is provided.
      Do not allow rainwater to increase the mixing water or damage the surface finish.
B. Cold Weather Concreting:
   1. Refer to ACI 306, “Recommended Practice for Cold Weather Concreting”.
2. Temperature of concrete when placed shall not be less than the following:

<table>
<thead>
<tr>
<th>Air Temp.</th>
<th>Minimum Concrete Temp. Degrees F</th>
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<tbody>
<tr>
<td>30 to 45</td>
<td>60</td>
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<tr>
<td>0 to 30</td>
<td>65</td>
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<tr>
<td>Below 0</td>
<td>70</td>
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<tr>
<td>Section with Least Dimension</td>
<td>12” and Over</td>
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<tr>
<td>Under 12”</td>
<td>12” and Over</td>
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<td>55</td>
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3. When placed, heated concrete shall not be warmer than 80° F.
4. Prior to placing concrete, all ice, snow, surface and subsurface frost shall be removed and the temperature of the surfaces to be in contact with the new concrete shall be raised above 35° F.
5. Protect the concrete from freezing during specified curing period.
6. Heated enclosures shall be strong and windproof to ensure adequate protection of corners, edges and thin sections. Do not permit heating units to locally heat or dry the concrete. Do not use combustion heaters during the first 24 hours, unless the concrete is protected from exposure to exhaust gases which contain carbon dioxide.

C. Hot Weather Concreting:
1. Refer to ACI 305, "Recommended Practice for Hot Weather Concreting".
2. Take precautions when the ambient air temperature is 90° F or above. Temperature of concrete when placed shall not exceed 85° F.
3. Cool forms and reinforcing to a maximum of 90° F by spraying with water prior to placing concrete.
4. Do not use cement that has reached a temperature of 270° F or more.
5. Do not place concrete when the evaporation rate (actual or anticipated) equals or exceeds 0.20 pounds per sq. ft. per hour.
6. Approved set-retarding and water-reducing admixtures may be used with the Architect/Engineer's approval when ambient air temperature is 90° F or above to offset the accelerating effects of high temperatures.

1.09 WARRANTIES

A. Provide Installer's written warranty covering defects in materials and workmanship, and subgrade failure for a period of one (1) year from final acceptance. Owner's Principal Representative shall determine needs for repairs or replacement, and his/her decision shall be final and obligatory upon the Contractor.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I/II. Use only one (1) brand of cement in any individual structure.
B. Fine Aggregate: Clean, sharp, natural sand conforming to ASTM C33.
C. Coarse Aggregate for Normal Weight Concrete: Clean, strong crushed gravel or stone conforming to ASTM C33. Gradation shall be as specified under concrete mixes.
D. Water: Clean, fresh potable supply, free from oil, acid, alkali, organic materials or other deleterious substances.
E. Admixtures: Use only when specified or approved by the Architect/Engineer.
   1. Air-Entraining Agent: ASTM C260, manufactured by Master Builders MBVR, Sika AER, Grace Darex AEA, Protex, or equal.
   2. Non-Chloride Accelerator: ASTM C494, Type C or E.
3. Retarder: ASTM C494, Type B or D.
5. Fly Ash: ASTM C618, Class C or F.
6. Calcium chloride or admixtures containing calcium chloride are specifically prohibited.
7. Color Additive: To be selected by the Architect from manufacturer's full line of color(s), Davis Color or equal. Provide colored concrete where shown or scheduled on the Drawings.
8. Fiber Reinforcing: Refer to Section 03200 and paragraph 3.02 of this Section.

F. LEED Design Criteria: Refer to paragraph 3.02, Design Mixes, of this Section.

2.02 CONCRETE ACCESSORIES

A. Expansion and Isolation Joint Fillers: Refer to Section 03100.
B. Miscellaneous Cast-in-Place Accessories: Refer to Section 03250.

2.03 CONCRETE CURING MATERIALS

A. Provide moisture-retaining cover of waterproof sheet materials complying with ASTM C171, Type I or Type II, polyethylene sheeting complying with AASHTO M-171, polyethylene coated burlap.

PART 3 EXECUTION

3.01 PREPARATION AND COORDINATION

A. Notify any trades that may have items to be embedded in concrete, or that may require openings in concrete, of placing schedule. Coordinate work to avoid cutting of concrete and to avoid delays in the work. This work may include, but is not limited to:
   1. Concrete reinforcing specified in Section 03200.
   2. Mechanical work specified in Division 15.
   3. Electrical work specified in Division 16.
B. Surfaces shall be true to line and grade and free from loose earth, frost, ice, mud and standing or running water. Protect bottom of excavation against freezing. Do not deposit concrete against frozen ground.
C. Make all preparations required for protection of concrete during placing and curing under detrimental weather conditions.
D. Notify the inspection agency at least 48 hours prior to placing of any concrete. Do not deposit any concrete before the inspection agency has observed reinforcement and other work in place and given permission to proceed. Such inspection and permission to proceed shall in no way relieve the Contractor of full responsibility for proper placement of reinforcement and placing of concrete and of responsibility for adherence to other requirements of the Construction Documents.
E. Form and install concrete work in accordance with ACI 301, except as amended by this Section. Concrete formwork shall be as specified in Section 03100.
F. Site preparation and compaction of existing and/or imported fill materials shall be in accordance with the requirements of the Soils Investigation Report and Section 02225. If the foundation/SOG structure design shown on the Drawings and/or specified will not strictly conform to this requirement, advise the Architect/Engineer before proceeding with work of this Section.
G. Ensure that form inserts for all exposed edges and corners requiring chamfers are properly placed, as specified in Section 03100.
H. Ensure that sleeves and other site items to be installed under concrete work are properly located and installed, as specified in other Sections.
I. Construction Indoor Air Quality Management:
   a. Manage indoor air quality in accordance with provisions of Section 01352.
J. Construction Waste Management and Disposal:
a. Manage construction waste in accordance with provisions of Section 01524.

3.02 DESIGN MIXES

A. Concrete mixes shall be as itemized on the Drawings or specified herein for specific locations.
B. Concrete which does not meet the minimum requirements for strength at 28 days shall be reviewed and is subject to removal at the option of the Architect/Engineer.
C. Proportion normal weight concrete in accordance with ACI 211.1. Concrete for all parts of the work shall be of the specified quality, capable of being placed without excessive segregation and, when hardened, of developing all characteristics required by these Specifications and the Contract Documents. Proportion ingredients to produce a mixture which will work readily into the corners and angles of the forms and around reinficons by the methods of placing and consolidation employed on the work.
D. Design mixes shall be made and reported by an approved testing laboratory for each class of concrete, at the Contractor’s expense.
E. Design mixes shall contain all admixtures required by these specifications and/or proposed by the Contractor to be used in concrete.
F. Proportion concrete design mixes so that compressive strength of laboratory-cured cylinders will be at least 15% greater than minimum specified strength. Refer to paragraph 1.05 for testing requirements.
G. Concrete Mixes:
   1. Concrete mixes are as indicated in the concrete mix table.
   2. Except as excluded, fly ash may be substituted for Portland cement to a maximum of 20% by weight. If used, no further cement reduction due to use of water-reducing agent will be allowed.
H. LEED Design Criteria:
   1. Credits MR 4.1 and 4.2, Recycled Content:
      a. Recycled Aggregate: 50% minimum.
      b. Fly Ash: As specified in subparagraph 3.02 G above.
   2. Credit MR 5.1, Local/Regional Materials, Manufactured Locally: Required. Contractor to provide information on locally manufactured products, in compliance with Section 01015.
   3. Credit MR 5.2, Local/Regional Materials, Harvested Locally: Required. Contractor to provide information on locally extracted, harvested or recovered materials, in compliance with Section 01015.
I. In lieu of designing new mixes for this project, existing mix designs meeting all requirements specified for each concrete mix and used successfully on previous projects under conditions similar to those anticipated on this project may be used, providing the following are submitted for the Architect/Engineer’s approval for each class of concrete:
   1. Reports of concrete mix design and test results.
   2. Reports of sufficient consecutive sets of 7- and 28-day concrete strength test made during the last six (6) months and the calculations of standard deviation for these tests.
   3. Reports of compliance tests of fine and coarse aggregates made during the last six (6) months.
   4. Mix submittals and required statistical strengths shall be in accordance with ACI 301.
J. Concrete Reinforcing: Refer to Section 03200.

3.03 CONCRETE BATCHING AND MIXING

A. Ready-mixed batch plant equipment and facilities must comply with the requirements of ACI 614 and ASTM C94. The plant must have sufficient capacity to produce and deliver concrete of specified qualities in quantities required to meet the construction schedule.
B. Site-mixed concrete will not be permitted. Measure, mix and deliver concrete in accordance with ASTM C94, except as specified herein.

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C. All concrete not placed within 90 minutes of initial contact of cement and water shall be rejected.
D. Indiscriminate addition of water to increase slump is prohibited. Obtain the Architect/Engineer’s approval for any addition of water. Do not exceed the maximum permissible water/cement ratio or maximum slump under any circumstances.

3.04 PREPARATION OF INSERTS, EMBEDDED ITEMS AND OPENINGS
A. Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.
B. Coordinate work of other Sections and cooperate with trades involved in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts.
C. Accurately position and securely fasten all anchored materials in the concrete.
D. Install conduits between reinforcing steel in walls or slabs with reinforcing in both faces and below reinforcing in slabs with only one (1) layer of reinforcing steel.
E. Embedments shall be clean when installed. Remove concrete spatter from all surfaces not in contact with concrete.

3.05 PLACING CONCRETE
B. Concrete shall have a temperature of $70^\circ F \pm 20^\circ F$ at the time of placing, unless prior permission has been granted in writing by the Architect/Engineer to exceed these tolerances.
C. Transport the concrete from mixer to final position as rapidly as practical without segregation, contamination or loss of material. Maximum not-to-exceed from introduction of water to placement of concrete is 90 minutes. Place concrete in forms with drop chutes, baffles or other methods which will prevent segregation. Comply with the requirements of ACI 614.
1. Contractor shall assess the placement requirements of the site, construction staging and other factors, and provide concrete pumping equipment for concrete placement as may be necessary, at no additional cost to the Owner.
D. Ensure that hardened concrete, wood chips, shavings and other debris have been removed from the interior of the forms and all hardened concrete and foreign materials have been removed from the inner surfaces of the mixing and conveying equipment. Forms shall be wetted, oiled or treated with an approved form-coating material prior to placing concrete. Reinforcement shall be cleaned, secured in position, inspected and approved by the Architect/Engineer before starting the pouring of concrete.
E. Concrete shall be deposited in the forms as nearly as practical in its final position so as to avoid rehandling. Special care shall be exercised to prevent splashing the forms or reinforcement with concrete in advance of pouring.
F. Place concrete in horizontal layers not more than 24” thick, unless otherwise required by specific conditions of the work. Place successive layers at such speed so that the preceding layer is still plastic.
G. Immediately after depositing, the concrete shall be compacted to force out all air pockets, working the mixture into corners, around reinforcement and inserts to prevent the formation of voids. Consolidate concrete by vibration, spading or rodding. Do not over-vibrate or use vibrators to transport concrete. Insert and withdraw vibrators vertically at uniformly spaced locations not farther apart than the visible effectiveness of the machine. Do not insert vibrators into lower layers of concrete that have begun to set.
1. Mechanical vibrators need not be used for thrust restraints.
2. When vibrating is not practical, concrete shall be consolidated and all faces well spaced by continuous working with a suitable tool in a manner acceptable to the Architect/Engineer.
3.06 INSTALLATION OF JOINTS

A. General: Locate and install construction joints which are not shown on the Drawings so as not to impair the strength and appearance of the structure.

B. Pour floor slabs in pattern indicated on the Drawings. Form control joints and place expansion joints as indicated on the Drawings, but in no case exceed the following requirements:
1. Control joints shall be spaced at 15'-0" maximum intervals each way so as not to encompass an area to exceed 225 sq. ft., or other spacing and pattern(s) as shown on the Drawings, or as required by the Soils Report.
2. Place control joints at internal corners, columns or other points of natural weakness.
3. Before depositing new concrete, remove all laitance and loose aggregates immediately before placing fresh concrete. Dampen but do not saturate the joint surface. At slabs and beams, apply a neat cement grout.

C. Expansion or Isolation Joints: Where expansion joints are indicated on the Drawings, place filler strips to within 1/2" of finished surface. Joint recess shall be formed with a separate removable filler section to provide a clean, true recess to receive sealant as specified in Section 07900.

D. Interior Construction and Control Joints: Keyed construction joints shall be formed with prefabricated joint materials and shall adhere to the control joint pattern shown.

E. Bond Breaker: Where shown on the Drawings, provide minimum two (2) layers 15# non-bituminous felt bond breaker between interior or exterior slabs-on-grade and vertical wall surfaces.

F. Column Isolation Joints: Joints around columns may be formed with minimum 30# non-bituminous building felt left in place with neatly trimmed top edge or approved joint filler material.

G. Exterior Slab, Curb and Gutter Control Joints: Tool or saw joints to a depth of one-fourth (1/4) the thickness of the slab, where indicated on the plans. Refer to Section 02515 for joint spacing in concrete curb and gutter, sidewalk and exterior flatwork sections.

3.07 FINISHING FLATWORK

A. General: Verify all flatwork finishes with the Architect in the field prior to proceeding with this work.

B. Float Finish: Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified. After screeding and consolidating concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to required tolerance. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint or other thin film finish coating system. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface. Consolidate the concrete surface by final hand-troweling operation, free of trowel marks, and uniform in texture and appearance. Grind smooth surface defects which would telegraph through applied floor coverings system. Finish surfaces to the following tolerances, according to ASTM E 1155, for randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for slabs-on-grade.

D. Non-Slip Broom Finish: After completion of floated finish, draw a broom or a burlap belt transversely across the surface perpendicular to the main traffic route. Use broom finish after floating for surfaces to receive topping or cementious finishes. Coordinate final texture with the
Architect prior to application.

E. Slab Finish Schedule:
   1. Interior Floor Slabs: Troweled finish.
   2. Exterior Sidewalks, Slabs and Ramps: Non-slip broom or sweat finish.

F. Finishing Slabs at Floor Drains: Hold elevation of concrete slabs-on-grade around floor drains level to within 16" around each drain location, then shape surface to elevation of drains as shown on the Drawings. Refer to the Drawings for special sloped areas of concrete slabs-on-grade to floor or trench drains.

3.08 TOLERANCES

A. Maintain the following tolerances for all cast-in-place concrete work. Defective work shall be removed and replaced at the Contractor's expense.

   1. Variation from Plumb:
      a. 0-10': 1/4" maximum.
      b. 20' or more: 3/8" maximum.

   2. Variation in Thickness: 1/4" to 1/2" standard, 5% for footings.

   3. Variation in Grade:
      a. 0-10': 1/4" standard, 1/8" for floor slabs.
      b. 10-20': 3/8" standard, 1/4" for floor slabs.
      c. 40' or more: 3/4" standard, 3/8" for floor slabs.

   4. Variation in Plan:
      a. 0-20': 1/2".
      b. 40' or more: 3/4" standard, +1/2" for footings.

   5. Variation in Eccentricity: 2% for footings.

   6. Variation in Openings:
      a. Size: +1/8".
      b. Location: 1/4".

B. Slab Tolerances:
   1. Interior Floor Slabs: See 3.07.C.
   2. Exterior Sidewalks, Slabs and Ramps: 1/4" in 10'.

3.09 CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening.

B. Refer to Section 03100 for stripping and removal of formwork after curing.

C. Refer to the manufacturer's written instructions and recommendations for curing of concrete slabs-on-grade to receive stains, sealers or other special finishes.

D. Start curing immediately after finishing. Cure for at least seven (7) days, not necessarily consecutive, during which air temperature surrounding concrete is above 50°F. Wood forms shall be kept wet. If forms are removed during curing period, an approved curing method must be started immediately.

E. Cure slabs by approved moisture-retaining coverings, lapped and sealed, and kept continuously wet. Approved curing compounds may be used if compatible with specified finishes. Specific approval is required from the Architect/Engineer. Curing compounds shall be applied in accordance with manufacturer's recommendations.

F. Contractor shall be responsible for protection of freshly placed concrete from vandalism, accidental damage by workmen or equipment, or damage resulting from subgrade settlement or subsequent construction traffic. Take adequate precautions to restrict traffic in the area of fresh concrete during the curing period. Damaged concrete shall be repaired or replaced by the Contractor at the Owner's discretion.

G. Comply with the requirements of ACI 305 when hot weather conditions exist. Temperature of 03300 - 10

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concrete when placed shall be less than 90°F. When necessary to prevent premature drying, arrangements for installation of windbreaks, shading, fog spraying, sprinkling, ponding or a wet covering of light color shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

H. Comply with the requirements of ACI 306 when cold weather conditions exist. When atmospheric temperature is 40°F and below, maintain concrete temperature at not less than 50°F for at least six (6) days. When necessary, make arrangements before concrete placing for heating, covering insulation or housing as required to maintain specified temperature and moisture conditions without injury due to concentration of heat.

I. Maintain protective cover on concrete so that changes in temperatures of concrete shall be as uniform as possible and shall not exceed 5°F in any one (1) hour or 50°F in any 24-hour period.

3.10 MISCELLANEOUS CONCRETE APPLICATIONS

A. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the Drawings or required by the work. Set anchor bolts for machines and equipment to template at correct elevations. Comply with certified diagrams or templates of the manufacturer furnishing machines and equipment.

3.11 DEFECTIVE CONCRETE

A. Remove and replace defective concrete not conforming to required line, detail and elevation as directed by the Architect/Engineer.

B. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, repair or replace exposed architectural concrete, except upon express direction of the Architect.

C. Concrete damaged after placement shall be repaired or replaced by the Contractor at the Owner’s discretion.

END OF SECTION
DIVISION 4 - MASONRY

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 04100
MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install mortar and grout materials for new brick masonry units.
B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 04210, Brick Masonry.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements and recommendations of applicable portions of standards listed.
   2. ASTM C144, Aggregate for Masonry Mortar.
   3. ASTM C150, Portland Cement.
   5. ASTM C270, Mortar Mix.
   9. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s product data and specifications for each type of mortar specified, including certification that each type complies with the specifications.
B. Samples: Submit samples of manufacturer’s full range of mortar colors for selection by the Architect.
C. Sample Panel: Refer to Section 04210 for sample panel requirements. Mortar color shall be reviewed for approval by the Architect.

1.04 TESTING

A. Inspection and testing shall be performed by an independent testing laboratory, approved by the Architect, conforming to ASTM E149 and C270. Testing fees shall be paid as specified in the General and Supplementary Conditions. Test samples shall be taken at random to provide sampling over the course of work. Materials not conforming to these specifications shall be removed from the job and replaced.
   1. Refer to Section 04210 for testing requirements.

1.05 ENVIRONMENTAL CONDITIONS

A. Maintain temperature of mortar and grout between 70°F and 100°F.
B. Contractor shall use only one (1) type mortar to ensure uniform color. Masonry cement is not permitted.
PART 2  MATERIALS

2.01 MORTAR AND GROUT MATERIALS

A. Portland Cement:  ASTM C150, Type 1, white.
B. Hydrated Lime:  ASTM C207, Type N for new construction.
C. Aggregate Sand:  ASTM C144.
D. Coarse Aggregate for Grout:   ASTM C404, less than 3/8”.
E. Water:  ASTM C270, clean and suitable for domestic consumption.
F. Mortar Coloring:
   1. Brick Masonry:  Dark Buff, SGS 20H by Solomon as basis of design.  Final color selection to be made as part of the mock-up assembly.
G. Admixtures:  Pozzolan with approval; calcium chloride not permitted.

2.02 MORTAR AND GROUT MIXES

A. Mortar Mixes:  ASTM C270, Type N mortar with hydrated lime for all new masonry construction.
   Minimum compressive strength of 750 psi at 28 days:
   1. 1 part Portland Cement, Type 1.
   2. 1 part hydrated lime.
   3. 5-1/2 parts damp, loose sand.
B. Masonry Grout Mix:  Minimum compressive strength of 3,000 psi at 28 days:
   1. 1 part Portland Cement, Type 1.
   2. 2-1/4 to 3 parts damp, loose sand.
   3. 1 to 2 parts coarse aggregate.
   4. Pozzolan as per manufacturer's recommendations.
   5. Air entrainment shall be not more than 5% by volume.
C. Mixtures may change as per manufacturer's recommendations to meet requirements.

PART 3  EXECUTION

3.01 INSPECTION AND PREPARATION

A. Masonry installer shall examine the areas and conditions under which masonry is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work.  Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the masonry installer.
B. Construction Waste Management and Disposal:  Manage construction waste in accordance with provisions of Section 01714.

3.02 BATCH CONTROL

A. Measure and batch materials either by volume or weight such that the required proportions for mortar can be accurately controlled and maintained.
B. Mix mortar ingredients for a minimum of five (5) minutes in a mechanical batch mixer.  Do not use mortar which has begun to set or if more than 2-1/2 hours has elapsed since initial mixing.  Retemper mortar during 2-1/2 hour period as required to restore workability.
C. Use mortar within two (2) hours of mixing at temperatures over 80° F, and 2-1/2 hours at temperatures under 50° F.
3.03 JOINTS

A. General: Lay coursed units with 3/8" joints, unless otherwise indicated, except for minor variations required to maintain bond alignment.

B. Bond Pattern and Joint Type: Refer to Section 04210.

C. Rake out mortar in preparation for application of caulking or sealants where shown.

D. Remove excess mortar and smears upon completion of work.

E. Point out or replace defective mortar to match adjacent work.

F. Clean soiled surfaces using a non-acidic solution which will not harm adjacent surfaces. Consult masonry manufacturer for acceptable cleaners.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install brick masonry veneer, including lintels and special shapes, mortar, ties, reinforcing, anchors and accessories.
B. Furnish and install brick masonry reinforcing, complete with required supports and related accessories.
C. Furnish and install flexible masonry flashings and create weepholes in veneer and/or composite wall construction.
D. Install loose lintels furnished by others.
E. Install all bolts, nailing blocks, inserts, door frames, vents, louvers, conduits and other related work furnished by others to be built into brick masonry.
F. Clean new brick masonry and remove surplus material and waste.
G. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 03250, Concrete Accessories.
   3. Section 04100, Mortar.
   4. Section 05400, Light-Gage Metal Framing.
   5. Section 07621, Galvanized Metal Flashing and Trim.
   6. Section 07900, Sealants and Joint Fillers.
   7. Section 08110, Standard Steel Doors and Frames.

1.02 QUALITY ASSURANCE

A. Conform to the current requirements and recommendations of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. ANSI A-41.1: Building Code Requirements for Masonry.
   4. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.03 SUBMITTALS

A. Samples: Submit a minimum of three (3) samples of each type, size and color of brick unit specified for approval before delivery to the project. Samples shall show shape, size and kind in sufficient number to show full range of color and texture. Final approval shall be by the Architect. One (1) color and size shall be used throughout the project.
B. Mock-up Sample Panel: Furnish and install masonry material consisting of approved brick masonry that satisfactorily shows proposed color range, texture, bond, anchorage, mortar and workmanship, including an internal and external corner condition, step and sill flashings, as well as special coursing such as soldier courses, rowlocks and insets.
   1. Contractor shall not continue work until Architect and Owner's representative have accepted sample panel.
   2. Sample panel shall remain on site until work of this Section is complete and will be used as standard of comparison for balance of work.
1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site on platforms or pallets. Keep masonry units completely covered and free from frost, ice and snow. Handle masonry carefully to avoid chipping, breakage, contact with soil or contaminating materials. Protect steel materials from moisture and keep free from rust or scale. Store mortar materials in dry place. Damaged material shall not be used.

B. Maintain protective boards at exposed external corners which may be damaged by construction activities. Provide such protection without damaging completed work.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 50°F prior to, during and 48 hours after completion of masonry work.

B. During freezing or near-freezing weather, provide adequate equipment or cover to maintain a minimum temperature of 50°F and to protect masonry work completed or in progress.

C. Protect partially completed masonry against weather when work is not in progress by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least 2’ down both sides of walls and anchor security in place.

D. Walls which may be exposed to high winds during erection shall be adequately braced until permanent support is provided at floor or roof level immediately above the story under construction.

E. Cold Weather Masonry Installation:
   1. Do not use frozen materials or materials mixed or coated with ice or frost.
   2. Do not use anti-freeze compounds, calcium chloride or substances containing calcium chloride in mortar or grout.
   3. Do not build on frozen work. Remove and replace masonry work damaged by frost or freezing.
   4. Protect masonry being placed from wind with enclosures or shields when air temperature is below 32°F.
   5. Do not heat water above 106°F.
   6. When mortar or grout materials have been combined, temperature of the mixture shall not be less than 70°F nor more than 100°F.
   7. Masonry materials shall be preconditioned and completed masonry protected as follows:
      a. When air temperature is below 40°F and above 32°F, heat mixing water. Protect masonry from rain or snow for 24 hours by means of waterproof covers.
      b. When air temperature is below 32°F and 20°F, heat both sand and mixing water. Maintain a temperature of at least 40°F on both sides of walls by means of suitable covers or enclosures for 24 hours.
      c. When air temperature is 20°F and below, heat sand, mixing water and brick and provide heated enclosures. A temperature of at least 40°F shall be maintained within enclosures for 48 hours.
      d. Periods required for protection and maintenance of specified temperatures may be reduced to 1/2 of those specified herein before if Type III Portland cement is used with the Engineer’s approval.

F. Hot Weather Masonry Installation:
   1. During very hot weather and drying wind, the Architect may order very light fog spray of mortar bedding areas several times during the first 24 hours to prevent premature drying of mortar.
PART 2  PRODUCTS

2.01  BRICK MASONRY UNITS

A.  Brick Masonry:  ASTM C216, Grade SW, Type FBX minimum standard.
1.  Size:  Nominal 2-1/4" high x 7-5/8" long face dimension x 3-5/8" deep modular veneer units.
2.  Style and Color:  As noted on the Drawings and outlined below:
   a.  Brick A:  Blend of 80% Monobuck and 20% Mission Autumn Gold.
3.  Appearance:  Units shall have smooth, dense, exposed surfaces free of cracks, chips or deleterious matter.  Representative sample in sample panel subject to approval by Architect.
4.  Special shapes as shown on the Drawings.

B.  Approved Manufacturers:
1.  Robinson Brick, no substitutes.

2.02  REINFORCING STEEL, ANCHORS AND TIES

A.  General:  Corrosion-resistant metal meeting or exceeding applicable standards ASTM A153 and ASTM A116.

B.  Horizontal Reinforcing Types:
1.  Wire Mesh:  Minimum 30-gage plain wire.  Mesh shall be 1/2" width, 1" (25mm) less than width of masonry.
2.  Truss Type for Single Wythe Masonry:  Prefabricated welded wire units not less than 10'-0" long, with matching corner and tee units.  Wire shall be 9-gage, with single pair of deformed side rods and continuous plain diagonal cross rods spaced not more than 16" o.c.

C.  Veneer Ties at Walls with Rigid Insulation:  #75 POS-I-TIE Brick Veneer Anchoring System by Heckmann, as basis of design.  Size length of wire ties as required to extend at least 2/3 of the way through bed joint of veneer with at least 5/8" cover on outside face.

D.  Approved Manufacturers:
3.  Manufacturers providing products of same performance and function are acceptable.

E.  Loose Lintels:  Reference Lintel Schedule on Structural Drawings.

2.03  BRICK MASONRY ACCESSORIES

A.  Flexible Masonry Flashings:  Non-reinforced homogenous, waterproof elastomeric sheeting, 20 mil minimum thickness.
1.  Tensile Strength:  2200 psi, minimum, STM D412.
2.  Elongation:  250%, minimum, ASATM D412.
4.  Flashing shall retain flexibility to a temperature of -20° F minimum.
5.  Materials and adhesive shall be as recommended by the manufacturer for the particular application.
6.  Approved Manufacturer:  Vi-Seal Plastic Flashing by AFCO Products, Inc., Somerville, MA, (800) 397-2687, or approved equal.

B.  Control Joints:
1.  Non-asphaltic-type foam backer rod by Celotex or equal.  Thicknesses as shown on the Drawings.
2.  Sealants specified in Section 07900.

C.  Mortar Dropping Collection and Weep:
1. 1" thick, high density polyethylene weave mesh type mortar dropping collector. Product is to be in a dovetail configuration connected by a continuous bottom strip.

2. Mortar dropping collectors and weephole vents shall be installed at the bottom of all brick masonry wall cavities, and both shall be by the same manufacturer.

3. Weep Hole Vents: Provide UV resistant recycled polyester mesh inserted in open head joints. Match weep vent color with mortar color. Weep vent and mortar dropping collector are to be by same manufacturer.

4. Manufacturers:
   b. Pre-approved equal.

2.04 INSULATION

A. Composite Wall Insulation: Refer to Section 07210, Building Insulation.

2.05 SEALER

A. Clear Masonry Sealer: Not applicable.

PART 3 EXECUTION

3.01 PREPARATION, COORDINATION AND WORKMANSHIP

A. Ensure that items built-in by other trades for this work are properly located and sized.
B. Establish all lines, levels and coursing. Protect from disturbance. Place brick masonry in accordance with lines and levels indicated on the Drawings.
C. Ensure masonry courses are of uniform height. Make vertical and horizontal joints equal and of uniform thickness.
D. Ensure that minimum 1” air space between masonry veneer units and wall sheathing is maintained.
E. Chases and recesses shall be built-in and not cut-in. Provide not less than 16” of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.
F. Unfinished masonry walls shall be stepped back for joining with new work. Do not tooth.
G. Cutting and fitting of masonry, including that required to accommodate the work of other Sections, shall be done by masonry mechanics with masonry saws.
H. Bearing for horizontal load-carrying members shall be of grouted masonry as shown on the Drawings. If no detail is shown, bearing under beams shall consist of grouted masonry at least 8” x 16” in plan and 16” deep.
I. Mask or otherwise protect doors and frames, louvers, mechanical and electrical equipment and other miscellaneous accessories not scheduled to receive masonry sealers prior to application of spray- or brush-applied sealers.
J. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 INSTALLATION OF MASONRY FLASHING

A. General: Install masonry flashings in locations specified here in or as shown on the Drawings. Place flashings in accordance with manufacturer’s instructions and recommendations and as detailed on the Drawings.
B. Place weepholes through bottom course of composite wall masonry construction as shown on the Drawings, but in no case to exceed 32” o.c. Form weep-holes one-half height, full depth of head joints, spaced as specified. Coordinate with Architect in the field as necessary.
C. Composite Wall Construction: Extend flashings through brick masonry, roll up face of steel stud wall construction minimum 6”. Lap end joints minimum 6” and seal watertight. Use flashing
manufacturer's recommended adhesive.

3.03 INSTALLATION OF MORTAR COLLECTOR/WEEPS

A. Preparation: Clean flashing and weep holes so they are free of mortar droppings and debris immediately prior to installing mortar collector.
B. For most walls, install one continuous row of mortar collector at base of wall and over all wall openings directly on flashing.
C. Lay the first one or two courses of brick at flashing level, then install mortar collector continuously by placing it against the inside of the openings. No fasteners or adhesives are required, and mortar need not have set.
D. Mortar collector shall not come in contact with wall ties standard wall tile installations, but if it does, it may be cut or torn to accommodate wall ties, conduit, plumbing or other materials that bridge or intrude into cavity between inner and outer walls.
E. Compress mortar collector horizontally so it can be forced into cavities slightly smaller than its nominal thickness without affecting mortar collector or wall performance.
   1. When forcing mortar collector into a cavity, be sure mortar has set sufficiently to resist outward pressure from product.
F. Install a minimum of three (3) weeps at each window and door head. Install weeps at 32” o.c. Open head joints for weep material to be a length of 1” for a consistent appearance. Space uniformly at window/door head for consistent appearance.

3.04 INSTALLATION OF BRICK UNIT MASONRY

A. Refer to Section 04100, Mortar, for installation and workmanship requirements for mortar and grout mixes.
B. Masonry Veneer: Install galvanized corrugated wall ties anchored to steel stud framing as shown on the Drawings at the following maximum spacing:
   1. Vertically: 24” o.c.
   2. Horizontally: At each stud; 16” o.c. maximum.
C. Lay masonry veneer units offset on foundation wall or brick ledge as required to maintain minimum 1” air space between masonry units and wall sheathing.
   1. Keep air space free from excess mortar.
D. Lay, level and align corner units first. Lay brick masonry in running bond, unless otherwise shown on the Drawings or specified herein. Course three (3) brick units and mortar joint to equal 8” vertically. Lay external and internal courses as shown on the Drawings.
E. Lay first course of brick masonry in full bed of mortar, except at locations of filled cores. Lay subsequent courses in face-shell mortar bedding properly jointed with other work. Fully mortar webs around each core to be grouted. Fully bond external and internal corners and intersections.
F. Rowlocks, Soldier Courses: Lay units to form special coursing patterns, or build-up to form corbels, as indicated on the Drawings.
G. Where a blend of brick colors is specified, disperse brick units in face of walls to blend colors uniformly, to the satisfaction of the Architect.
H. Perform job site cutting of masonry units with proper power tools to provide straight, true and unchipped edges.
I. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
J. Remove excess mortar and projections. Take care to prevent breaking brick corners. Clean excess mortar from cores to be grouted.
K. Tooling and Joints: Refer to paragraph 3.05.
3.05 MORTAR BEDDING AND JOINTS

A. Head joints shall be well buttered for thickness equal to face shell of unit and shall be shoved tightly so that mortar bonds well to both units. Do not slush head joints.
B. Mortar protrusions extending into air space for veneer masonry shall be removed.
C. Joint width shall be 3/8”, unless otherwise shown.

3.06 TOOLING

A. Exposed Joints: Tool joints as scheduled. Rake out mortar in preparation for application of caulking or sealants where required.
B. Concealed Joints: Cut joints flush, unless otherwise shown, if applicable.
C. Joints to be covered with paint shall be filled flush and then sacked to produce dense surface without sheen.
D. Joints which are not tight at the time of tooling shall be raked out, pointed and then tooled.

3.07 TOLERANCES

A. Maintain the following tolerances:
   1. Maximum variation from masonry unit to adjacent masonry unit: 1/32”.
   2. Maximum variation from vertical and horizontal building lines: 1/4”.
   3. Maximum variation from cross sectional thickness of walls: +/- 1/4”.
   4. Maintain flush face on exposed brick surfaces.

3.08 INSTALLATION OF HORIZONTAL JOINT REINFORCEMENT

A. General: Reinforce all walls with continuous horizontal joint reinforcement, unless specifically shown otherwise. Provide special shapes where shown on the Drawings. Lap reinforcement minimum 6” at splices.
B. Composite Wall Construction: Ensure that cavity wall horizontal reinforcing has been properly embedded in concrete block backup. Embed free end of reinforcing in every sixth mortar joint of brick veneer.
C. At each level, place reinforcement in bed joint at regular intervals not exceeding 16” o.c. vertically.
D. Place reinforcement so that longitudinal wires are located over face-shell mortar beds and are fully embedded in mortar for their entire length with minimum mortar cover of 5/8” on exterior side of walls and 1/2” at other locations.
E. Unless otherwise shown, provide reinforcement in first and second bed joints of composite wall construction immediately above and below openings or recesses in walls. Reinforcement shall extend minimum 24” beyond end of sills or lintels or to end of panel if distance to end of panel is less than 24”.
F. Use only prefabricated “L” and “T” units at corners and intersections, respectively.
G. Do not bridge control and expansion joints with reinforcement, unless shown on the Drawings.

3.09 INSTALLATION OF VENEER TIES

A. General: Install masonry veneer ties to solid wall sheathing or other substrate at spacing specified in paragraph 3.04 above, unless specifically noted otherwise on the Drawings. Place at maximum 3” o.c. each way around perimeter of openings, within 12” of openings.
3.10 INSTALLATION OF LINTELS

A. General: Install loose lintels where shown on the Drawings or required for a complete installation.
B. Masonry Lintels: Provide where shown and whenever openings of more than 12" but less than 30" are shown without steel or other lintels. Temporarily support formed-in-place lintels.
   1. Refer to the Drawings for loose lintel schedule.
C. Bearing: Unless otherwise shown, provide minimum bearing of 6" for openings less than 6'-0" wide and 8" for wider openings.
D. Place control joint materials in accordance with manufacturer’s written instructions, recessed in joint for caulking as specified in Section 07900.

3.11 INSTALLATION OF CONTROL AND EXPANSION JOINTS

A. Locate vertical control, expansion and isolation joints in brick masonry as shown on the Drawings. Joints shall be continuous through depth of the masonry work, unless otherwise detailed.
B. Maintain control joint voids clear of mortar, grout and debris. Rake out mortar in preparation for application of caulking and sealants.
C. Control Joint Spacing: If location of control joints is not shown, place vertical joints maximum 32" o.c. for brick masonry, except as specified herein:
   1. Masonry Veneer: Locate vertical control joints in continuous runs of masonry veneer so ratio of horizontal run to vertical height of veneer does not exceed 4:1, or maximum 20'-0", whichever is greater.
   2. Locate joints at points of natural weakness in supporting structure and at wall openings.

3.12 INSTALLATION OF LIMESTONE WAINSCOT, CAPS, LINTELS AND COPING UNITS

A. General: Install miscellaneous limestone units, furnished by others, as shown on the Drawings.
B. Bearing: Unless otherwise shown, provide minimum bearing of 6" for openings less than 6'-0" wide and 8" for wider openings.
C. Place control joint materials in accordance with manufacturer’s written instructions, recessed in joint for caulking as specified in Section 07900.

3.13 BUILT-IN WORK

A. As work progresses, build-in hollow metal frames, signage, electrical and mechanical accessories, anchor bolts, plates, specialties and other items supplied by others. Place items plumb and true to line.

3.14 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit sleeves and other items as required. Cooperate fully with other Sections to ensure correct size, shape and location.
B. Obtain Architect’s approval prior to cutting or fitting any area which is not indicated on the Drawings or which may impair appearance or strength of masonry work.

3.15 POINTING

A. Completely remove excess mortar from masonry to be exposed or painted before setting or hardening. Mortar smears will not be allowed on finished work. Before completion of work, rake out defective joints to a depth of 3/4", fill with mortar and tool to match existing joints.
3.16 CLEANING AND PROTECTION

A. General: All new brick masonry shall be thoroughly cleaned upon completion of the work.  
B. Adhere to the following procedures for cleaning brick. Never clean brick before mortar has set, minimum 14 days. Use acid only for difficult cleaning cases.  
1. Dry clean wall with wood paddles or scrapers, removing large particles of mortar.  
2. Presoak wall with clean water, scrub with a solution of 1/2 cup trisodium phosphate and 1/3 cup household detergent to a gallon of water.  Scrub with a stiff fiber brush only.  
3. Thoroughly rinse with clean, low-pressure water immediately after scrubbing to remove all cleaning solution, dirt, and mortar crumbs.  
4. For difficult stains, clean surface with a 6% solution of muriatic acid applied with a stiff fiber brush to not more than 10 sq. ft. of water-soaked wall. Rinse immediately with clean water. Clear all weepholes of loose mortar and debris.  
5. Leave surfaces prepared for further sealers or coatings, if specified. 
C. Remove and replace any chipped or broken brick units. Remove excess mortar and smears upon completion of masonry work.  Point or replace defective mortar to match adjacent work.

3.17 FIELD QUALITY CONTROL

A. General: Installation of masonry units, mortar and grout, special curing and workmanship of joints shall be in accordance with the standards approved in the sample panel.  
B. All brick masonry units shall be sound and free of cracks or other defects that may interfere with the proper placing of the unit or impair the strength or performance of the construction.  
C. Where masonry units are to be exposed in the completed construction, the face or faces that are exposed shall be free of chips, cracks or other imperfections to the satisfaction of the Architect, except that chips not larger than 1/4” will be considered acceptable.  
D. Contractor shall promptly remove any rejected masonry units or portions of the work and replace to match the quality of the approved sample panel.

END OF SECTION
DIVISION 5 - METALS

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 05300

METAL DECKING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install all materials required for complete installation of metal floor decking.
B. Furnish and install all materials required for complete installation of metal roof decking.
C. Related work specified elsewhere:
   1. Section 01015, LEED Requirements.
   2. Section 01714, Construction Waste Management.
   3. Section 05400, Light-Gage Metal Framing.
   4. Section 09900, Painting.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with provisions of the following codes and standards, except as otherwise shown or specified:
   1. AISI, “Specification for the Design of Light-Gage Cold-Formed Steel Structural Members”.
   2. AWS, “Code for Welding in Building Construction”.
   4. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Fabricator shall be a member of the Steel Deck Institute (SDI).
   1. All metal decking shall be by the same fabricator throughout the project, unless specifically approved otherwise by the Architect/Engineer.
C. Welding Qualification: Contractor shall qualify welding processes and welding operators in accordance with the AWS “Standard Qualification Procedure”.
   1. Welded decking in place is subject to inspection and testing. Remove and replace or reweld work found to be defective and not complying with the specifications.
D. LEED Compliance: Refer to Section 01015 for submittal and documentation requirements for Credits MR 4.1, 4.2, 5.1 and 5.2.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s product literature, load tables, performance and test data.
B. Shop Drawings: Submit shop drawings, including erection plans and details, deck types, gage and properties, erection marks and sequence of erection, welding diagrams and instructions, type of shop finish coat, accessories and installation instructions.
C. LEED Submittals:
   1. Credit MR 4.1 and MR 4.2: Product Data indicating percentages by weight of postconsumer and preconsumer recycled content for metal decking.
      a. Include statement that indicates costs for each product having recycled content.
   2. Material Source (MRC5):
      a. Submit product data or other published information verifying the location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer’s documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc. and the distance between this location and the project site. Also include material costs (excluding costs of installation).
      b. Include information on Material Tracking Worksheets.
3. **Low-Emitting Paints and Coatings (EQc4.2):**

1.04 **DELIVERY, STORAGE AND HANDLING**

A. Deliver materials to the site with necessary erection markings.
B. Handle and store in a manner required to avoid damage to decking. Store above ground on platforms, skids or similar supports; slope to permit drainage.
C. Keep free from dirt or other foreign matter. Protect against rust and corrosion by means of weatherproof covering. Tie or weigh down broken bundles of deck to prevent wind from blowing sheets.

**PART 2  PRODUCTS**

2.01 **METAL FLOOR AND ROOF DECKING**

A. General: Type of floor and roof decking shall be as indicated on the Drawings.
B. Materials:
   1. Steel for Galvanized Deck Units: ASTM A446, Grade A with 1.25 oz./sq. ft. “commercial” class zinc coating complying with ASTM A525.
C. Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanized surfaces, complying with MIL-P-21035.
D. LEED Design Criteria:
   1. Credits MR 4.1 and 4.2, Recycled Content: 50% minimum.
   2. Credits MR 5.1, Local/Regional Materials, Manufactured Locally: Required. Contractor to provide information on locally manufactured products, in compliance with Section 01015.
   3. Credit MR 5.2, Local/Regional Materials, Harvested Locally: Contractor to provide information on locally extracted, harvested or recovered materials, in compliance with Section 01015.
E. Approved manufacturers:
   2. Vulcraft, Norfolk, NE, (402) 644-8500.
   5. Approved equivalent.

2.02 **DECK DESIGN CRITERIA**

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with “SDI Specifications and Commentary for the Steel Roof Deck,” in SDI Publication No. 30, and with the following:
   1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as noted on Drawings, G60 (Z180) zinc coating: cleaned, pretreated, and primed with manufacturer’s standard baked-on, rust-inhibitive primer.
   2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.

2.03 ACCESSORY MATERIALS

A. General: Provide end and side closures, column closures, sump pans and bent plates and other miscellaneous shapes as indicated on the Drawings or as required by project conditions but not itemized.
B. Cover Plates: Fabricate metal cover plates for end abutting deck units of not less than 18-gage sheet steel formed to match contour of deck units.

2.04 FACTORY-APPLIED FINISHES

A. Provide Manufacturer's standard galvanized finish on all surfaces.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Contractor shall check all lines and levels and verify existing conditions prior to commencing work of this Section. Notify the Architect/Engineer in writing of any discrepancies or conditions which may affect the successful installation of the work. Do not begin work until conditions have been corrected in a manner acceptable to the Erector.
B. Construction Indoor Air Quality Management: Manage indoor air quality in accordance with provisions of Section 01352.
C. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 INSTALLATION OF METAL DECKING

A. General: Place units on supporting steel and adjust to final position before final welding. Units shall be straight and true and have proper bearing on supporting steel.
B. Roof Deck: Fasten roof units as indicated on the Drawings.

3.03 APPLICATION OF TOUCH-UP PAINT

A. After installation, wire brush, clean and paint scarred area, welds and rust spots on the top and bottom surfaces of decking units and supporting steel members.
B. Touch up galvanized surfaces with galvanized repair paint applied in accordance with the manufacturer's instructions. Touch up painted surfaces with the same type of paint on the adjacent surfaces.

3.04 INSTALLATION OF REINFORCEMENT AT OPENINGS

A. General: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work, unless otherwise shown.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install light-gage structural metal framing, including all shapes and accessories required for complete installation of exterior and interior load-bearing light-gage wall, exterior non-load bearing light-gage wall, soffit and parapet framing work, roof joist framing, and roof trusses and roof rafter framing.

B. Related work specified elsewhere:
   1. Section 01015, LEED Requirements.
   2. Section 01714, Construction Waste Management.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with provisions of the following codes and standards, current edition, except as otherwise shown or specified:
   1. AISI, “Specification for the Design of Light-Gage Cold-Formed Structural Members” and “Light-Gage Cold-Formed Steel Design Manual”.
   2. AWS, “Code for Welding in Building Construction” and “Recommended Practice for Spot Welding of Low-Carbon Steel”.
   3. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

B. Installer Qualifications: Installer experienced in performing light gage work of this section who has specialized in installation of load bearing light gauge framing work similar to that required for this project.

C. LEED Compliance: Refer to Section 01015 for submittal and documentation requirements for Credits MR 4.1, 4.2, 5.1 and 5.2.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s written product literature illustrating all structural properties of specified framing systems.

B. LEED Submittals:
   1. Credit MR 4.1 and MR 4.2: Product Data indicating percentages by weight of postconsumer and preconsumer recycled content for metal framing materials.
      a. Include statement that indicates costs for each product having recycled content.
   2. Material Source (MRc5):
      a. Submit product data or other published information verifying the location of manufacturing facility including name, address, and distance between manufacturing facility and the project site. Provide manufacturer’s documentation indicating location where the base materials were extracted, mined, quarried, harvested, etc. and the distance between this location and the project site. Also include material costs (excluding costs of installation).
      b. Include information on Material Tracking Worksheets.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site with necessary erection markings.
B. Handle and store in a manner required to avoid damage to studs. Store above ground on platforms, skids or similar supports sloped to permit drainage.
C. Keep free from dirt or other foreign matter. Protect against rust and corrosion by means of weatherproof coverings.

PART 2 PRODUCTS

2.01 METAL FRAMING COMPONENTS

A. Steel for Light-Gage Framing:
   1. Galvanized 16-Gage Studs and Joists: Conform to ASTM A446, Grade D. (50,000 psi minimum yield strength).

B. Studs and Roof Joists: All studs and joists shall be of the type, size and gages shown on the Drawings or specified herein.
C. Accessories: Provide manufacturer’s standard structural accessories as indicated on the Drawings or as required for a complete installation, including but not limited to:
   3. Web stiffeners:
      a. Width: 4 inches (102 mm).
   4. Angles, channels and flat straps.
   5. Load-Bearing Headers:

D. Fasteners: Self-drilling, self-tapping screws; Steel, complying with ASTM C1513; Galvanized coating, plated or oil-phosphate coated complying with ASTM B 633 as needed for required corrosion resistance.

E. Welding: Welded electrodes complying with AWS requirements for welding low-carbon steel.

F. Finish:
   1. Galvanized: Provide manufacturer’s standard G-60 galvanized coating, conforming to ASTM A525 and C955.

G. LEED Design Criteria:
   1. Credits MR 4.1 and 4.2, Recycled Content: 95% minimum.
   2. Credits MR 5.1, Local/Regional Materials, Manufactured Locally: Required. Contractor to provide information on locally manufactured products, in compliance with Section 01015.
   3. Credit MR 5.2, Local/Regional Materials, Harvested Locally: Contractor to provide information on locally extracted, harvested or recovered materials, in compliance with Section 01015.

H. Approved Manufacturers:
   2. The Steel Network, Inc. Raleigh, NC (888) 474-4876
   3. Steel Benders Inc., Commerce City, CO.
   5. Manufacturers providing materials of the same function and performance may be submitted for approval as an alternate.

2.02 FABRICATION

A. General: Framing components shall be prefabricated into panels prior to erection to the greatest extent possible.
B. All framing members shall be cut to fit tightly against abutting members. Studs shall be seated squarely in track with stud web and flange abutting track web within 1/16”.
C. Axially Loaded Studs:
1. Install studs to have full bearing against inside track web (1/16” maximum gap) prior to stud and track attachment.

2. Splices in axially loaded studs are not permitted.

D. Precompress stud wall panels in bearing walls to eliminate seating settlement.

E. Frame stud members into prefabricated panels at 24” o.c. maximum, or as shown on the Drawings.

F. Fabricate panels for reinforcement at door, window and louver openings as specified in paragraph 3.02 below.

G. Fasteners: Fasten components using self-tapping screws or welding.

H. Welding: Welding is permitted on 16 gage or heavier material only.
   1. Specify welding configuration and size on the Structural Calculation submittal.
   2. Qualify welding operators in accordance with Section 6.0 of AWS D.1.3.
   3. Touch up all welds with zinc-rich paint in compliance with ASTM A 780.

I. Provide continuous track at top and bottom of panels. Splices in track shall be butt-welded.

J. Prefabricated panels shall be square with other components, free from twist, bends and open joints and shall be braced against racking.

K. Shop-weld structural shapes into final position after they have been accurately positioned and aligned.

L. Prior to painting, clean all steel as required. Apply paint by methods required to provide uniform, dry film thickness of 2 mils minimum.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Contractor shall check all lines and levels and verify existing conditions prior to commencing work of this Section. Notify the Architect/Engineer in writing of any discrepancies or conditions, which may affect the successful installation of the work. Do not begin work until conditions are corrected in a manner acceptable to the Erector.

B. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 ERECTION

A. General Erection Requirements:
   1. Install cold-formed framing in accordance with requirements of ASTM C1007 and with manufacturer’s written instructions and recommendations.
   2. Weld in compliance with AWS D.1.3.
   3. Install in compliance with applicable sections of the AISI Standard for Cold-Formed Steel Framing General Provisions.

B. Handle and erect framing members by methods required to avoid damage to members and work in place. Damaged members shall be repaired or replaced as directed by the Architect/Engineer.

C. Wall Openings: Fabricate and/or erect all panels with reinforced edges for openings as follows:
   1. Jambs of doors, windows and louvers over 3'-0" high: As shown on the Structural Drawings but not less than double studs each side of opening, attached together at 16” o.c. maximum. Run studs full height of wall, unless otherwise shown.
   2. Headers of door, window and louver openings in load-bearing partitions: Double members, or as shown on the Drawings.
   3. Headers of door, window and louver openings in non load-bearing partitions: Jack studs or cripples, or as shown on the Drawings.
   4. Sills of window and louver openings: Jack studs or cripples or as shown on the drawings.

D. Anchor track by power-driven fasteners spaced not over 16” o.c. Each piece of track shall have at least two (2) fasteners.

E. Fastening: A fusion-welding unit of DS (straight polarity) or AC (buzz box) current of 200 amperes.
or less is recommended. A welding heat of 60-110 amperes, depending on material gage and fit of components, with 3/32” or 1/8” AWS Type 6013 is recommended.
1. Self-drilling self-tapping metal screws provide an alternate method of assembling light-gage structural steel framing provided screw manufacturer’s recommendations are followed. Values of screw pullout and shear must be equal to the specified welds.
F. Coordinate spacing and installation with Masonry Contractor for installation of masonry veneer ties.
G. Touch up abrasions and welds with specified paint.

3.03 ERECTION (COLD-FORMED STEEL JOISTS)

A. Joists shall be located directly over bearing studs within 3/4“ or a load distribution member shall be provided at the top track.
B. Provide web stiffeners at reaction points where indicated on the Drawings.
C. Joist bridging shall be provided as shown on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Inspection: Periodic special inspections are required by local code authorities.
   1. Contractor shall hire and pay inspection agency.
   2. Submit schedule showing when the following activities will be performed and resubmit schedule when timing changes.
   3. Notify inspection agency not less than 3 days before the start of any of the following activities.
   4. Inspections are required during welding operations, screw attachment, bolting, anchoring and other fastening of components within the force resisting structural system, including struts, braces, and hold-downs.

END OF SECTION
PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish and install miscellaneous fabricated items of ferrous and non-ferrous metals as shown on the Drawings, including but not limited to:
   1. Miscellaneous steel channels, angles, lintels, and straps, if not furnished by other Sections.

B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 09900, Painting.

1.02  WORK FURNISHED BUT INSTALLED BY OTHERS

A. Section 03300, Cast-in-Place Concrete: Metal fabrications cast in concrete.
B. Section 04210, Brick Masonry: Loose lintels and metal fabrications laid into brick masonry.

1.03  QUALITY ASSURANCE

A. Reference Standards: Conform to requirements of the following standards and codes:
   1. ASTM A36: Structural Steel.
   2. ASTM A307: Low-Carbon Steel Externally and Internally Threaded Fasteners.
   3. ASTM A325: High-Strength Bolts for Structural Steel Joints.
   6. FS TT-P-645: Primer, Paint, Zinc-Chromate, Alkyd Type.
   8. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.04  SUBMITTALS

A. Product Data: Submit manufacturer’s written product literature for any miscellaneous or specialty metal fabrications not submitted under separate Sections.

B. Shop Drawings: Submit shop drawings illustrating dimensions, components, spacing of predrilled holes for anchorage, finishes and shop welds or other attachments.

C. Shop Drawings: Submit shop drawings of any miscellaneous or specialty metal fabrications not submitted under separate Sections.

PART 2  PRODUCTS

2.01  STEEL MATERIALS

A. Structural Steel: Conform to ASTM A36.
B. Structural Tubular Steel: Square, cold-rolled steel tubing, fully welded construction. Conform to ASTM A500, Grade B.
C. Structural Steel Pipe: Comply with ASTM A53, Grade B.

2.02 FABRICATION

A. Shop-fabricate and assemble items in largest practical components for delivery and installation on the site. Extent of shop assembly shall be as approved in the shop drawings.
B. Fabricate items with joints neatly fitted and properly secured.
C. Grind exposed welds smooth and flush with adjacent finished surfaces.
   1. All welds exposed to view to be “Architectural Grade.”
D. Supply components required for proper anchorage of metal fabrications. Fabricate anchorage and related components of same material and finish as metal fabrication, unless otherwise specified.
E. Thoroughly clean surfaces of rust, scale, grease and foreign matter prior to prime painting.
F. Prime paint items for field finishing as specified in Section 09900. Do not shop-prime surfaces in contact with concrete or requiring field welding. Shop-prime in one (1) coat.
G. Hot-dipped galvanize all items to be installed in exterior locations or to be in contact with concrete.

PART 3 EXECUTION

3.01 PREPARATION

A. Contractor shall check all lines and levels and verify existing conditions prior to commencing work of this Section. Notify Architect/Engineer of any discrepancies or conditions which may affect the successful installation of the work. Do not begin work until such conditions are corrected in a manner acceptable to the Installer.
B. Contractor shall field verify all dimensions affecting the work of this Section and coordinate fit and installation details with related trades prior to fabrication.
C. Ensure that items required to be cast into concrete or embedded in masonry are supplied to the site prior to concrete or masonry work, complete with necessary setting templates.
D. Ensure that ferrous metal surfaces have been properly painted where in contact with aluminum or other dissimilar metals as required to prevent electrolysis.
E. Pipe Bollards: Ensure that bollards have been properly located in relation to openings in concrete, masonry or other materials or equipment to be protected by the bollards. Unless otherwise shown on the Drawings or required by specific site requirements, locate bollards as follows:
   1. Jambs: Centerline of bollard aligned with centerline of jamb opening, and placed 12” out from face of wall.
   2. Corners: Centerline of bollard placed 12” out from corner in both directions.
   3. Equipment: Centerline of bollard placed 12” out from edge or corner of gas meters, electrical transformers, pad-mounted condensing units and other equipment. Coordinate clearance requirements with utility providers, as applicable.
F. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 INSTALLATION

A. General: Install prefabricated items in accordance with manufacturer’s written instructions and recommendations. Install items square and level, accurately fitted and free from distortion.
B. Make provision for erection stresses by temporary bracing. Keep work in alignment.
C. Replace items damaged in course of installation.
D. Perform field welding in accordance with AWS D1.1.
E. Pipe Bollards: Embed bollards minimum 24” deep into concrete piers with a minimum dimension of
12" diameter x 36" depth below grade, unless otherwise shown on the Drawings.

1. Fill bollards with concrete and form top surface smooth, dense, and crowned to a maximum of 1/4" allow proper drainage.

PART 4 SCHEDULES

4.01 SCHEDULE OF MISCELLANEOUS METALS

A. Pipe Bollards: 6" o.d. steel pipe x 6'-0" long (24" embedment), concrete filled, as detailed on the Drawings.

B. Miscellaneous Steel Channels, Angles, Lintels and Straps: Furnish under this Section, unless arranged for otherwise.

END OF SECTION
DIVISION 6 - WOOD AND PLASTICS

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish materials and labor for installation of rough carpentry, including but not limited to:
   1. Pressure-treated dimensional lumber for "bucks" at all openings.
   2. FRT and pressure-treated furring, stripping, blocking and sleepers.
   3. Studs, joists, bridging, blocking and plates for wall, roof, ceiling and soffit framing.

B. Furnish nails, screws, bolts, fasteners, construction adhesives, and other related or accessory materials required for a complete installation.

C. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 05300, Metal Decking.
   3. Section 05400, Light-Gage Metal Framing.
   4. Section 06160, Exterior Glass Mat Gypsum Sheathing.
   5. Section 07621, Galvanized Metal Flashing and Trim.
   6. Division 15, Mechanical.
   7. Division 16, Electrical.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to requirements of the following standards and codes:
   1. PS 1: Construction and Industrial Plywood.
      b. AWPA C9: Plywood - preservative treatment by pressure processes.
      c. AWPA C15: Wood for commercial-residential construction - preservative treatment by pressure processes.
   8. WRCLA: Western Red Cedar Lumber Association.
   9. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

B. All plywood shall be identified with the grade mark of an approved quality assurance agency and shall meet the following standards:
   2. ASTM D6305.
   3. ASTM E84.
   4. ASTM E162.

C. Plywood panels shall be identified with APA grade trademark of the American Plywood Association.

D. Rough Carpentry Lumber: Materials shall carry the visible grade stamp of agency certified by National Forest Products Association (NFPA).
1.03 SUBMITTALS
A. Shop Drawings and Product Data: Submit shop drawings and/or manufacturer’s written product literature for FRT plywood sheathing.
B. Preservative Treatment Certification: Treating plant’s certification of compliance with specified standards, process employed and preservative retention values.

1.04 DELIVERY, STORAGE AND HANDLING
A. Protect plywood and keep under cover in transit and at job site.
B. Do not deliver material unduly long before it is required to be installed in the work.
C. Store on level racks and keep free of the ground to avoid warping. Stack to ensure proper ventilation and drainage.
D. Pressure-Treated Wood Materials: Protect wood products against moisture and dimensional changes, in accordance with instructions from treating plant.
E. Deliver packaged materials in manufacturer’s original unbroken boxes or cartons or containers, with labels intact. Store in accordance with manufacturer’s instructions and recommendations.
F. Construction Waste Management and Disposal:
   1. Manage construction waste in accordance with provisions of Section 01524.

1.05 COMPLIANCE
A. Do not permit materials not complying with the provisions of this Section to be brought onto or to be stored at the jobsite.
B. Promptly remove non-complying materials from the jobsite and replace with materials meeting the requirements of this Section.

1.06 WARRANTIES
A. Provide manufacturer’s written lifetime warranty for pressure-treated wood products covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 PRESSURE-TREATED AND FRT ROUGH CARPENTRY MATERIALS
A. Miscellaneous Plates, Blocking, Furring and Sleepers: PS 20, grade in accordance with established WPA grading rules, maximum moisture content of 12% to 19% (S-Dry) S4S, with preservative treatment specified below, of the following species and grades:
   1. Non-Structural Light Framing: Douglas Fir or Hem-Fir, construction grade or better.
   2. Sill Plates: Pressure-treated Hem-Fir, where in contact with concrete or masonry.
B. Framing Lumber: PS 20, grade in accordance with established WPA grading rules, maximum moisture content of 12% to 19% (S-Dry) S4S, of the following species and grades:
   1. Structural Framing: Hem-Fir #2 or better, minimum 1,200 psi fiber stress in bending, unless other grades and stresses are indicated on the Structural Drawings.
   2. Studs: Douglas Fir or Hem-Fir, standard grade or better.

2.02 PLYWOOD MATERIALS
   1. 4'-0" wide x 8'-0" long x 5/8" thick or as shown on the Drawings.
B. Approved Manufacturers:
2. Weyerhaeuser Corp., Tacoma, WA.
4. Manufacturers providing products of the same design, function, quality and performance are acceptable.

2.03 FASTENERS, ACCESSORY MATERIALS AND COMPONENTS

A. Bolts, Nuts, Washers, Lags, Pins and Screws: Size and type to suit application or as indicated on the Drawings.
   1. Medium Carbon Steel: Galvanized for exterior locations, high-humidity locations and treated wood; plain finish for other interior locations or when in contact with concrete.
B. Construction Adhesives: Mastic-type, multipurpose adhesive, formulated for field gluing for interior or exterior use, meeting the following specifications:
   1. Reference Standards:
      a. APA Spec. AFG-01.
      b. ASTM D3498-76.
      c. HUD/FHA requirements in Bulletin UM-60.
   2. Type: Solvent dispersion.
   4. Consistency: Approx. 200,000 cps, Brookfield viscometer.
   5. Weight/Gallon: 8.8 lbs. minimum.
   6. Solids content: 64%, +/- 2%.
   7. Strength: 400 psi by ASTM D905-49 (wood to wood).
   10. Application Method: Caulking gun or trowel.
   11. Application Temperature: 25°-120° F.
   12. Service Range: -25° to +150° F.
   14. Approved Product and Manufacturer: M-D 400 Construction Adhesive, manufactured by Macklanburg-Duncan, Oklahoma City, OK or equal.
C. Roof Sheathing: #10 Roofgrip screws by Buildex, at 6” o.c. at panel edges and 12” o.c. in the field.

2.04 WOOD TREATMENTS

A. Preservative Treatment: Where lumber or plywood is indicated on the Drawings or specified herein to be pressure-treated, comply with applicable requirements of AWPA standards C2, C9, C14, C15, C16, C17 or ICBO ER4981, as applicable. Pressure-treat items with waterborne preservatives complying with WPA LP-2, except that in no case shall chromated copper arsenate (CCA) be used. After treatment, kiln dry to a maximum moisture content of 19% for lumber and 18% for plywood. Mark each treated item with the WPA quality mark requirements.
   1. Application Rates: Apply specified preservative treatment as follows, or as recommended by approved manufacturers:
      a. Preservative treatment for above ground use: 0.25 lb./cu.ft. minimum.
      b. Preservative treatment where in contact with ground: 0.40 lb./cu.ft. minimum.
   2. Treated wood products shall be used in the following locations, unless otherwise shown on the Drawings:
      a. In contact with roofing, flashing or waterproofing.
      b. In contact with masonry or concrete.
      c. In contact, or within 6” of grade.
      d. Exposed to weather.
      e. Other locations indicated.
B. Fire-Retardant Treatment: Where fire-retardant or treated lumber or plywood is indicated or required by applicable building codes, comply with AWPA C20 for lumber and C27 for plywood, using types required for interior and exterior use.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. General: For new construction, the Contractor shall inspect the metal stud framing and metal decking that will support the sheathing associated with the work of this project, and notify the Architect/Engineer of any condition that may affect the structural integrity, quality or appearance of the completed project. Do not commence work until such defects have been corrected to the satisfaction of the Contractor.

B. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 INSTALLATION OF ROUGH CARPENTRY AND SHEATHING

A. General:
1. Erect wood framing, furring, stripping and nailing members and sheathing true to lines and levels; do not deviate from true alignment more than 1/4", with allowances for expansion and contraction.
2. Space members as indicated on the Drawings or scheduled herein.
3. Construct members of continuous pieces of longest possible lengths.

B. Fastening:
1. Screws: Type "S" bugle-head screws, self-tapping, rust-resistant; size, length and spacing as noted on the Drawings.

3.03 PROTECTION

A. Protect plywood sheathing from exposure to excessive moisture and accumulations of snow.

B. Replace sheathing panels that exhibit delamination, swelling or other deterioration from exposure to moisture, or as directed by the Architect.

3.04 COORDINATION

A. Contractor shall be responsible for the coordination required by all other Sections of the Specifications as a part of the work of this Section. Coordination shall be provided to ensure the proper, timely and complete installation of all materials, equipment and systems of the project.

END OF SECTION
SECTION 06160

EXTERIOR GLASS MAT GYPSUM SHEATHING

PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish and install exterior glass mat gypsum sheathing on exterior walls and soffits over light-gage metal structural framing in cavity wall construction.
B. Furnish and install exterior glass mat gypsum sheathing on exterior parapet walls over light-gage metal structural framing as substrate for roof base flashings.
C. Furnish and install exterior glass mat gypsum sheathing as roof cover board, unless provided by Division 7 Section(s).
D. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 05400, Light-Gage Structural Metal Framing: Exterior structural framing.
   3. Section 06100, Rough Carpentry.
   4. Section 07536, Thermoplastic Sheet Roofing - Fully Adhered.

1.02  QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements and recommendations of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's written product literature and installation instructions indicating compliance with these Specifications.

1.04  DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in original, unopened packages, containers or bundles with labels intact bearing type, brand name and name of manufacturer.
B. Handle sheathing carefully to avoid abrading surfaces or edges.
C. Store materials flat, under cover, on level platforms, with edges, ends and surfaces properly protected from weather, undue sagging and damage.

1.05  ENVIRONMENTAL CONDITIONS

A. Maintain ambient temperatures at not less than 55°F for a period of 24 hours before drywall finishing, during installation and until compounds are dry.

PART 2  PRODUCTS

2.01  EXTERIOR GLASS MAT GYPSUM SHEATHING

A. General: Paperless exterior gypsum structural sheathing board, consisting of a moisture-resistant treated core surfaced with glass mat facings and bond-enhancing primer coating, mold resistant,
conforming to ASTM C1177.
1. Sheathing: 5/8” thick, maximum permissible length(s), tapered edges.
2. Panel Size(s): 4'-0" x 8'-0".
3. Physical Properties:
   a. R-Value: 0.47 minimum.
   b. Flame Spread: Class A, less than 25 when tested in accordance with ASTM E84.
   c. Water Absorption: Less than 10%.
   d. Water Vapor Transmission: 10 perms minimum.
B. Exterior Glass Mat Gypsum Sheathing on Exterior Walls in Cavity Wall Construction: DensGlass Gold Exterior Wall Sheathing as basis of design.
C. Approved Manufacturers:
   2. Manufacturers providing materials of same function and performance are acceptable, as approved prior to bidding.

2.02 GLASS MAT GYPSUM SHEATHING ACCESSORIES
A. General: Provide gypsum wallboard accessories in accordance with GA 216.
B. Adhesive: Provide polymer-modified cementitious adhesive (El Rey Insul-Bond L) between the insulation board and exterior glass mat sheathing.
C. Fasteners: Type “S” bugle-head screws, lengths as recommended by manufacturer of gypsum wallboard material for light-gage steel construction.
D. Control Joints: As shown on the Drawings. Where sheathing is used as a substrate for Exterior Finish System (EFS).
E. Provide auxiliary materials and accessories for glass mat gypsum sheathing work of the type and grade recommended by the manufacturer.
F. Corner Beads and Edge Trims: Manufacturer’s standard galvanized steel beaded units with flanges for concealment in joint compound.
G. Sealants:
   1. Method 1: Dow Corning 795, Pecora 895 or equal.
   2. Method 2: Pecora AC-20 acrylic latex sealant, GE silicone Silpruf, Tremco Dymonic or equal.
H. Joint Tape: 2” wide 10x10 glass mesh quick tape.
I. Joint and Skim Coat Compound: ToughRock 90 setting type joint compound.

PART 3 EXECUTION
3.01 INSPECTION AND PREPARATION
A. Installer shall examine the structural framing and substrates to receive exterior glass mat gypsum sheathing and the conditions under which the sheathing is to be installed and notify Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
B. Installer shall comply with all applicable instructions and recommendations of the exterior Portland cement stucco finish system manufacturer, as applicable.
C. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.
3.02 GLASS MAT GYPSUM SHEATHING INSTALLATION

A. General: Install exterior glass mat gypsum sheathing in accordance with the manufacturer's written instructions and the recommendations of GA 253. All construction shall be in compliance with the required fire-rated wall assemblies.

B. Fire-Rated Gypsum Sheathing: Apply gypsum sheathing panels of maximum practical length with long dimensions at right angles to studs with "V" edge up and fasten with type "S" screws, spaced as required by the manufacturer for the span and thickness specified. End joints shall occur over supports with end joints staggered. Properly support panels around cutouts and openings.

C. Place control joints at locations as indicated on the Drawings or as per manufacturer's recommendations. Joints shall not be placed at intervals greater than that recommended by gypsum sheathing manufacturer for the particular application.

D. Place corner beads at external corners. Use longest practical lengths. Place edge trim where gypsum sheathing abuts dissimilar materials and at reveals. Tape joints as required for listed fire-rated assembly. Tape, fill and sand exposed joints, edges, corners, openings and fixings to produce surface ready to receive surface finishes.

E. Attach sheathing to metal framing with screws spaced at 8" o.c. at perimeter and 8" o.c. along intermediate framing unless otherwise noted on the Drawings.
   1. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
   2. Locate fasteners minimum 3/8" from edges and ends of sheathing panels.

F. Caulk joints with sealants as recommended for long-term weather protection against wind, air infiltration and water penetration per one of the two methods below.

   G. Caulk Joints:
      1. Method 1: Apply a 3/8" bead of sealant to all joints and trowel in firmly until flat. Apply caulk to cover each fastener completely when troweled flat. Use backer rod for openings greater than 1/8".
      2. Apply glass mesh joint tape to all joints. Apply a 3/8" bead of caulk along joint. Embed the caulk into the entire surface of the tape with a trowel. Use backer rod on joints over 1/8". Apply caulk to cover each fastener completely with troweled flat.

3.03 CLEANING

A. Remove soil, stain and extraneous materials caused by installing of sheathing materials from adjacent surfaces.

B. Remove and replace items and materials that cannot be satisfactorily cleaned.

C. Leave surfaces clean and prepared for further exterior finish work.

3.04 PROTECTION OF WORK

A. Installer shall advise Contractor of required procedures for protection of the exterior gypsum sheathing work from damage and deterioration during the remainder of the construction period.

END OF SECTION
SECTION 06200

FINISH CARPENTRY

PART 1  GENERAL

1.01  WORK INCLUDED

A. Installation of the following items, unless arranged for otherwise:
   1. Interior plywood sheathing.
   2. Hollow metal doors and frames.
   3. Solid surface window sills.
   4. Finish hardware specified in Division 8.
   5. Building specialties specified in Division 10.

B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 06200, Rough Carpentry.
   4. Section 09900, Painting.
   5. Section 10520, Fire Protection Specialties.

1.02  QUALITY ASSURANCE

A. Fabricate finish carpentry items in accordance with recommendations and quality standards of Architectural Woodwork Institute (AWI).

B. Reference Standards: Conform to quality requirements of current editions of the following standards:
   1. PS 51: Hardwood and Decorative Plywood.
   2. PS 58: Basic Hardwood.
   4. WWPA: Western Wood Products Association
   6. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

PART 2  PRODUCTS

Not used.

PART 3  EXECUTION

3.01  PREPARATION

A. Contractor shall field measure conditions as required for the successful installation of all finish carpentry items.

B. Installer shall examine the rough framing, wall blocking and other substrates and finishes under which the finish carpentry work is to be performed and notify the Contractor in writing of any condition that will prevent the successful installation of the work of this Section. Do not proceed with the installation until the unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Proceeding with the work shall be considered acceptance of substrates and site conditions.
3.02 INSTALLATION OF ITEMS SUPPLIED BY OTHER SECTIONS

A. Install doors and frames, windows, finish hardware, fixtures, accessories, specialties and equipment supplied under other Sections for installation. Install items in accordance with manufacturer’s instructions and recommendations.

END OF SECTION
DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 07210

THERMAL BUILDING INSULATION

PART 1  GENERAL

1.01 WORK INCLUDED

A. Furnish and install building insulation materials to provide thermal and vapor barrier for building elements and spaces, including:
   1. Unfaced rigid board insulation in exterior wall construction and at exterior grade beam foundation walls.
   2. Foil-faced batt insulation in exterior wall and roof construction.
   3. Foamed-in insulation at perimeter of all shimmed door and window frames in exterior walls and around bar joist members.
B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 06160, Exterior Glass Mat Gypsum Sheathing.
   3. Section 07221, Tapered Rigid Insulation: Tapered and coordinating flat, rigid board roof insulation materials.
   4. Section 07270, Air Infiltration Barriers.
   5. Section 07536, Thermoplastic Sheet Roofing - Fully-Adhered.
   6. Section 07900, Sealants and Joint Fillers.
   7. Section 08110, Standard Steel Doors and Frames: Requirements for foamed insulation in hollow metal doors and frames.
   8. Division 15, Mechanical.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. ASTM C1289: Faced Rigid Polyisocyanurate Insulation Board.
   4. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction over this Project.
B. Certification: Manufacturers shall certify that insulation materials are free of asbestos and urea formaldehyde and are non-toxic.
C. Certification: Fiberglass materials for interior building installations shall be GreenGuard certified for indoor air quality.
D. Certification: Installer shall install an insulation certification card upon completion of the insulation work as specified in paragraph 3.04.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's product literature and specifications indicating compliance with the requirements of this Section for each type of insulation material specified. Clearly mark each submittal for R-value of insulation material being furnished.

1.04 DELIVERY, STORAGE AND HANDLING

A. Furnish materials in manufacturer's original packaging, complete with installation instructions.
B. Store materials away from sources of intense heat such as open flames or welder's torches.
C. Protect materials from exposure to moisture and sunlight with an opaque light-colored tarp or equal.

1.05 WARRANTIES

A. Provide the manufacturer's written warranty covering materials, workmanship and retention of R-value of insulation materials for the following terms:
   1. Faced and Unfaced Blanket Insulation: One (1) year.
   2. Foil-Faced Rigid Board Insulation: Fifteen (15) years.

PART 2 PRODUCTS

2.01 EXTRUDED POLYSTYRENE BOARD INSULATION

A. General: High-density, extruded polystyrene rigid board insulation, square edges. Compressive strength of 25 psi. R-value of 5.0 minimum per inch at 75°F K-value of 0.20.
   1. Apply over exterior wall sheathing at masonry veneer conditions.
      a. Thickness: 1”, R-value of 5 minimum.
   B. Approved Manufacturers:
      2. Foamular 250, UC Industries, Chicago, IL.
      3. Amofoam CM or RCY, Amoco Foam Products Co., Atlanta, GA, (800) 241-4402.
      4. Manufacturers providing materials of same function and performance are acceptable.

2.02 BATT INSULATION, FOIL-FACED

A. General: Flame-resistant, foil-skrim-kraft laminate faced glass or other inorganic fibers and resinous binders formed into flexible blankets, flame spread/smoke rating of 25/50 or less when tested in accordance with ASTM E84. Density not less than 1.5 lbs. per cu. ft. K-value of 0.27 at 75°F. R-value as indicated on the Drawings.
   1. Apply in framed exterior walls, vaulted ceilings and attics, or as indicated on the Drawings.
   2. Apply in concealed spaces designed as return air plenums.
   B. Sizes: Provide manufacturers' standard rolls, roll width as follows:
      1. Steel Stud Framing at 16” o.c.: 16” wide.
   C. R-Value:
      1. R-19 at exterior cavity walls.
      2. R-38 in roof construction.
   D. Approved Manufacturers:
      2. CertainTeed, Valley Forge, PA, and distributed from Arlington, TX, (817) 461-5535.
      4. Knauf Insulation GmbH, Shelbyville, IN, (800) 825-4434.
      5. Manufacturers providing materials of same function and performance are acceptable.

2.03 FOAMED-IN INSULATION

A. General: Two-component foamed-in-place polyurethane insulation system, Class A fire rating when tested in accordance with ASTM E-84.
   1. Apply in cavity space around all doors, louvers and other shimmed spaces.
   2. Apply at all joints and gaps in exterior rigid insulation.
   3. R-value: 3.8 per inch minimum, ASTM C518.
4. Compressive Strength: 2.8 lbs./sq. in. minimum, ASTM D1621.
5. Tensile Strength: 5.7 lbs./sq. in. minimum, ASTM D1623.
6. Shear Strength: 7.1 lbs./sq. in. minimum, ASTM C273.
7. Apply in all perimeter voids between framing and shimmed door and window frames.

B. Approved Manufacturers:
2. Manufacturers providing materials of same function and performance are acceptable.

2.04 INSULATION ATTACHMENTS AND ACCESSORIES

A. Adhesive or Attachments: Type recommended by insulation manufacturer, capable of securely adhering insulation to applicable surfaces.
B. Vapor Barrier: Specified in Section 07190.
C. Tape: 2” wide self-adhering type, polyethylene-faced.
D. Air Infiltration Wrap: Specified in Section 07270.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall examine the surfaces, substrates, wall, floor and attic/ceiling cavities and conditions under which the insulation work is to be performed and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the insulation work until the unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
B. Ensure that building shell has been completely and properly “dried in” prior to installation of thermal insulation materials.
C. Ensure that insulation baffles have been properly installed in attic spaces.
D. Ensure that all electrical lighting fixtures, mechanical equipment and other devices protruding into rafter, attic or soffit cavities are properly rated to be in contact with insulation. If they are not, Contractor shall build enclosures around such fixtures to hold insulation materials away as required by the fixture manufacturer’s warranty and installation requirements. Maintain tops of enclosures open to allow adequate ventilation of fixtures and devices.
E. Installer shall discuss specific site conditions with the Architect concerning the proper selection of appropriate materials for ceiling/attic installations, as referenced in Paragraph 3.03.
F. Construction Indoor Air Quality Management: Manage indoor air quality in accordance with provisions of Section 01352.
G. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 WORKMANSHIP

A. General: Cut and trim insulation neatly to fit spaces. Butt edges and ends tight.
B. Install insulation to fit tightly between framing members and fill all voids.
C. Fit insulation tight against mechanical, electrical and other items which protrude through plane of insulation; fit insulation to outside of plumbing in exterior walls.
D. Ensure that cavities, chases and other void spaces open to attics are sealed with insulation, unless used as approved mechanical plenums.
3.03 INSTALLATION OF EXTRUDED POLYSTYRENE BOARD INSULATION

A. General: Install rigid board insulation materials in accordance with the manufacturer’s written instructions and recommendations. If instructions do not apply to project conditions, consult with manufacturer’s technical representative before proceeding with the work.

B. Ensure that surfaces which are to receive board insulation are clean, free of deleterious matter and are sufficiently level to allow proper installation of insulation.

C. Install rigid insulation to maintain continuous and complete thermal protection for building spaces and elements. Use board insulation free of broken or chipped edges.

D. Secure rigid insulation on perimeter foundation walls and underside of slabs with specified adhesive or other attachment using spot or bead method in accordance with insulation manufacturer’s recommendations. Place insulation horizontally and stagger vertical joints.

3.04 INSTALLATION OF BLANKET-TYPE BATT INSULATION

A. General: Install batt insulation materials in accordance with the manufacturer’s written instructions and recommendations. Use unfaced, paper-faced or foil-faced insulation materials as scheduled herein, or required by the provisions of applicable building codes.

B. Use batt insulation free of ripped back or edges, with vapor barrier intact.

C. Install batt insulation in wall cavities without visible gaps or separations. Use roll widths as required for type and spacing of framing members, as scheduled above. Fit insulation tight within spaces and tight to and behind mechanical and electrical services.

D. Install batt insulation and vapor barrier in accordance with manufacturer’s recommendations. Install after mechanical and electrical services within walls have been installed. Provide R-value as indicated on the Drawings or specified herein.

E. Install insulation with vapor barrier membrane facing warm side of building spaces. Lap ends and side flanges of membranes over framing members. Tape in place. Tape seal butt ends and lapped side flanges and ends. Do not tear or cut membranes.

F. Place vapor barrier on interior face of insulation by taping to framing members. Tape seal areas where wires penetrate vapor barrier.

G. Extend vapor barrier tight to full perimeter of adjacent items interrupting the plane of membrane. Tape seal in place.

H. Suspended Roof/Attic Areas: Hang insulation along lines of roof/attic cavities where shown on the Drawings using specified hanger wire strung between framing members.

I. Install to surround steel roof beams and other structural members, if present.

3.05 INSTALLATION OF FOAMED-IN DOOR AND WINDOW FRAME INSULATION

A. General: Install foamed-in-place insulation in all perimeter voids between framing and shimmed door and window frames, in accordance with the manufacturer’s written instructions and recommendations.

1. It is not the intention of this specification to fill the voids of aluminum storefront framing sections or other hollow assemblies, unless specifically specified elsewhere.

B. Install insulation to completely fill all cavities and voids.

C. Install at all butt joints and gaps between rigid insulation boards.

3.06 INSULATION CERTIFICATION

A. Upon completion, the Installer shall install an insulation certification card in the attic space of each unit or applicable portion of building, at the access panel, stating the following information:

1. Name of installer.
2. Date of installation.
3. Manufacturer(s) of insulation materials installed.
4. Types of insulation materials installed.
5. R-values of insulation materials installed.

END OF SECTION
SECTION 07220
ELASTOMERIC SHEET ROOFING INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install rigid board-type roof insulation to provide thermal and vapor barrier for building elements and spaces.
B. Furnish and install glass-faced gypsum or cementitious fiber cover board over rigid roof insulation.
C. Related work specified elsewhere:
   1. Section 01015, LEED Requirements.
   2. Section 01714, Construction Waste Management.
   3. Section 07210, Building Insulation.
   4. Section 07221, Tapered Rigid Insulation.
   5. Section 07536, Thermoplastic Sheet Roofing - Fully-Adhered.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable requirements of the following standards.
   2. Applicable Federal Specifications (FS) for materials as specified herein.
   5. CAN/ULC 5770: Long-Term Thermal Resistance of Materials.
   6. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Certification: Manufacturer shall certify that insulation materials supplied are compatible with sheet roofing membrane specified.
C. Certification: Manufacturers shall certify that insulation materials supplied are free from asbestos and urea formaldehyde and are non-toxic.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and specifications indicating that materials supplied meet the requirements of this Section. Clearly mark each submittal for R-value of material being furnished.

1.04 DELIVERY, STORAGE AND HANDLING

A. Furnish material in manufacturer's original packaging, complete with installation instructions.
B. Store materials away from sources of intense heat such as open flames or welder's torches.
C. Protect materials from exposure to moisture and sunlight with an opaque light-colored tarp or equal.

1.05 WARRANTIES

A. Provide manufacturer's written warranty covering materials, workmanship and retention of R-value of insulation materials in conjunction with the warranty specified for the membrane roofing specified in Section 07531.
   1. Rigid Board Insulation: Fifteen (15) years.
PART 2 PRODUCTS

2.01 ROOF SYSTEM DESCRIPTION

A. Single-ply membrane roof system supplier and installer shall ensure that roof insulation materials provided are compatible with the roofing system specified and approved by the roof membrane manufacturer for use in this system.

2.02 EXTRUDED POLYISOCYANURATE BOARD INSULATION

   1. R-Value: 30 minimum, aged per ASTM C518.
   2. Thickness: 5" or as required to meet thermal requirements specified above. In no case shall thickness be less than that required to meet Factory Mutual I-90 criteria. Two (2) layers of 2-1/2" thick boards with staggered joints.
   3. Properties:
      c. Moisture Vapor Transmission: 2 perm. inches, ASTM C355-64.
      d. Dimensional Stability: Less than 2% linear change, ASTM D2126.
      e. Service Temperature: -100°F to 250°F.
      g. Flame Spread: Less than 25 (Class A), ASTM E84.
   4. Board Size: 48" wide x 96" long x 2-1/2" thick or manufacturer's standard.
   5. Facings: Manufacturer's standard organic/inorganic facers.

B. Fiber Cants: Provide fiber cants, complying with the sheet roofing manufacturer's requirements and compatible with the insulation materials specified, if required by the manufacturer for the roofing system specified.

C. Accessories: Provide other products as required by manufacturer for a complete and thermally sealed system.

D. Fasteners: Screws, type and length as recommended by the manufacturer for mechanical attachment to roof sheathing.
   1. Sure-Seal fasteners and insulation plates by Carlisle or equal.

E. Approved Manufacturers:
      a. Energy 3 Rigid Roof Insulation, as basis of design.
   5. Rmax, Inc., Dallas, TX, (800) 527-0890.
   6. Temple-EasTex, Inc., Diboll, TX, (800) 231-6060.
   8. Manufacturers providing materials of same function and performance are acceptable.

2.03 COVER BOARD

A. General: Furnish manufacturer's standard 1/2" thick, glass-faced gypsum board sheathing, 48" wide x 96" long or manufacturer's standard.
   2. Manufacturers providing materials of same function and performance are acceptable, if approved by roof insulation and/or roofing manufacturer as part of the specified roof assembly.
PART 3  EXECUTION

3.01  INSPECTION AND PREPARATION

A. Installer shall examine the roof substrate and conditions under which the insulation work is to be performed and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the insulation work until the unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Beginning work shall be considered acceptance of substrate.

B. Ensure that surfaces which are to receive roof insulation are clean, dry, free of deleterious matter and are sufficiently level to allow proper installation of insulation.

C. Ensure that plywood crickets, if shown on the Drawings or required by project conditions, are properly located, constructed and anchored in place.

D. Nothing in this Section shall be construed to relieve the Contractor of ultimate responsibility for the satisfactory completion of the work.

3.02  INSTALLATION OF ROOF INSULATION

A. General: Install rigid board insulation systems in accordance with manufacturer's written instructions and recommendations. Installation shall be consistent with local building codes and insurance requirements and meet the requirements of the sheet roofing manufacturer.

B. Install roof insulation to maintain continuous and complete thermal protection for building spaces and elements. Boards shall be installed with long joints continuous and end joints staggered. Cut and trim insulation neatly to fit spaces. Butt edges and ends tight.

C. Cut around rooftop equipment curbs, skylights, pipe vents and exhaust fans to provide tight-fitting joints. Cut into roof drains as required for proper drainage.

3.03  INSTALLATION OF COVER BOARD

A. General: Install cover board in accordance with manufacturer's written instructions and recommendations. Installation shall be consistent with local building codes, insurance requirements and meet the fire rating requirements of the sheet roofing manufacturer.

   1. Installation: Mechanically attached. Fasteners shall extend through the rigid board roof insulation and be securely attached to the metal decking.

3.04  PROTECTION

A. Continually protect the roof insulation from moisture by installing only as much insulation as can be properly covered by the sheet roofing each day. Provide temporary water seals, temporary ballast and end-of-workday water cut-offs. Protect insulation from wind blow-off during all phases of construction.

B. Clean and protect exposed surfaces of insulation and leave prepared for roofing application. Refer to Section 07531.

END OF SECTION
SECTION 07221
TAPE R D RIG ID INSULATI ON

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install tapered rigid board roof insulation system for formed drainage crickets as shown on the Drawings.
B. Furnish and install cementitious fiber cover board over tapered rigid roof insulation.
C. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 07210, Building Insulation.
   3. Section 07220, Roof Insulation: Standard rigid board insulation.
   4. Section 07536, Thermoplastic Sheet Roofing - Fully-Adhered.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable requirements of the following standards.
   2. Applicable Federal Specifications (FS) for materials as specified herein.
   3. FS HH-I-524C, Type 1, and ASTM C578-83 for expanded polystyrene.
   4. ASTM C578, Type II: Expanded Polystyrene.
   5. ASTM C578, Type IV: Extruded Polystyrene.
   6. ASTM E84: Surface burning characteristics of building materials.
   7. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Certification: Manufacturers shall certify that insulation materials are free from asbestos and urea formaldehyde and are non-toxic.
C. Certification: Manufacturer shall certify that insulation materials supplied are compatible with sheet roofing membrane specified.

1.03 SUBMITTALS

A. Product Data: Submit complete manufacturer's product literature and specifications indicating compliance with the requirements of this Section. Clearly mark each submittal for R-value of insulation material being furnished.
B. Shop Drawings: Shop drawings indicating slopes of tapered rigid insulation system, material thicknesses, proposed system layout, accessories and details for approval by the Architect.

1.04 DELIVERY, STORAGE AND HANDLING

A. Furnish materials in manufacturer's original packaging, complete with installation instructions.
B. Protect materials from exposure to moisture and sunlight with an opaque light-colored tarp or equal.

1.05 WARRANTIES

A. Provide manufacturer's written warranty covering materials, workmanship and retention of R-value of insulation materials in conjunction with the warranty specified for the membrane roofing specified in Section 07531.
1. Rigid Board Insulation: Fifteen (15) years.

PART 2 PRODUCTS

2.01 ROOF SYSTEM DESCRIPTION

A. Single-ply membrane roof system supplier and installer shall ensure that roof insulation materials provided are compatible with the roofing system specified and approved by the roof membrane manufacturer for use in this system.

2.02 ROOF INSULATION MATERIALS

A. General: Composite roof insulation system consisting of tapered rigid board insulation and coordinating flat rigid board insulation, to provide a continuous thermal barrier over the gross area of the roof.
   1. Total R-Value: 30 minimum, or as indicated on the Drawings.
   2. Tapered Rigid Insulation System: Factory-tapered expanded or extruded polystyrene insulation to provide minimum surface slope of 1/4” per foot when installed over new decking, unless indicated otherwise on the Drawings.
      1. Minimum Density: 1.0 pcf.
      3. Average R-Value: 4.17 per inch thickness at 40°F (mean temperature) minimum.
      4. Board Sizes: 48” wide x 96” long, or manufacturer's standard.
      5. Properties:
         b. Water Absorption: 0.01%, ASTM C209.
         c. Thermal Conductivity (K-Value): 0.185 at 40°F mean.
         d. Flame Spread: Less than 25 (Class A), ASTM E84.
   C. Roof Deck Insulation: Manufacturer's standard square edge expanded or extruded polystyrene rigid board insulation for installation over steel roof deck. Refer to Section 07220.
   D. Fiber Cants: Provide fiber cants, complying with the sheet roofing manufacturer's requirements, and compatible with the insulation materials specified, if required by the manufacturer for the roofing system specified.
   E. Accessories: Provide other products as required by manufacturer for a complete and thermally sealed system.
   F. Fasteners: Screws, type and length as recommended by the manufacturer for application.
      1. Sure-Seal fasteners and insulation plates by Carlisle or equal.
   H. Approved Manufacturers:
         a. Tapered Energy 3 Rigid Roof Insulation as basis of design.
      5. Manufacturers providing materials of same function and performance are acceptable only as approved by the Architect prior to bidding.
PART 3 EXECUTION

3.01 PREPARATION

A. Installer shall examine the roof substrate and conditions which the insulation work is to be performed and notify Contractor in writing of unsatisfactory conditions. Do not commence work until such defects have been corrected to the satisfaction of the Installer. Beginning work shall be considered acceptance of substrates.

B. Thoroughly clean the new steel deck substrate prior to installation of tapered rigid and board insulation systems.

C. Ensure that surfaces which are to receive roof insulation are clean, dry, free of deleterious matter and are sufficiently level to allow proper installation of insulation.

D. Nothing in this Section shall be construed to relieve the Contractor of ultimate responsibility for the satisfactory completion of the work.

3.02 INSTALLATION OF ROOF CRICKETS

A. General: Install built-up roof crickets, minimum 1/4” per foot slope, whether specifically shown on the Drawings or not, as required for adequate roof drainage, including but not limited to the following locations:
   1. Roof valleys, as required to direct water to roof drains or scuppers.
   2. Mechanical equipment curbs.
   3. Roof hatch curbs.
   4. Other equipment curbs or other items projecting through the roof surface.

3.03 INSTALLATION OF TAPERED ROOF INSULATION SYSTEM

A. General: Install tapered rigid and flat board insulation systems in accordance with manufacturer’s written instructions and layout shown on the approved shop drawings. Installation shall be consistent with local building codes and insurance requirements, and meet the requirements of the sheet roofing manufacturer.

B. Install roof insulation to maintain continuous and complete thermal protection for building spaces and elements. Boards shall be installed with long joints continuous and end joints staggered. Cut and trim insulation neatly to fit and butt ends and edges together tightly.

C. Take necessary precautions to prevent breakage of rigid insulation materials laid directly over fluted metal roof deck. Limit foot traffic on completed sections. Remove and replace any broken panels.

D. Cut around rooftop equipment curbs, skylights, pipe vents and exhaust fans to provide tight-fitting joints. Cut into roof drains as required for proper drainage.

3.04 PROTECTION

A. Continually protect the roof insulation from moisture by installing only as much insulation as can be properly covered by the sheet roofing each day. Provide temporary water seals, temporary ballast and end-of-workday water cut-offs. Protect insulation from wind blow-off during all phases of construction.

END OF SECTION
SECTION 07270
AIR INFILTRATION BARRIERS

PART 1  GENERAL

1.01 WORK INCLUDED

A. Furnish and install air infiltration wrap for exterior metal framed wall construction.
B. Furnish and install self-adhesive moisture/air infiltration flashings at doors and other openings in framed wall construction.
C. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 06100, Rough Carpentry: Sill seal.
   3. Section 07210, Building Insulation.
   4. Section 07900, Sealants and Joint Fillers.
   5. Division 8, Doors and Windows.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to current requirements and recommendations of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   6. FS UU-B-790a, Type 1, Grade A, Style 4, ICBO Evaluation Report No. 1025.
B. Installer: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the work of this Section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s written product literature, specifications or technical data indicating compliance with the requirements of this Section for each type of air/moisture infiltration material specified.

1.04 DELIVERY, STORAGE AND HANDLING

A. Furnish materials in manufacturer’s original packaging, complete with installation instructions.
B. Store materials away from sources of intense heat such as open flames or welder's torches.
C. Protect materials from exposure to moisture and sunlight with an opaque light-colored tarp or equal.

1.05 ENVIRONMENTAL CONDITIONS

A. General: Follow manufacturer’s written specifications and recommendations for product handling and application.
B. Ensure that surface temperature or the surrounding air temperature is between 40° F and 120° F before installation. Consult manufacturer if installation must be done at temperatures below the minimum.
1.06 WARRANTY

A. Provide manufacturer's written one-year warranty for materials and workmanship.

PART 2 PRODUCTS

2.01 AIR INFILTRATION WRAP - COMMERCIAL

A. General: Air infiltration membrane designed to prevent airflow through metal framed wall cavities, hold out bulk water and wind-driven rain/snow and act as breathable membrane to allow moisture vapor to escape from within walls.

B. Material: Spunbonded Olefin fiber, non-woven, non-perforated secondary weather-resistant barrier.
   1. Roll Size: 9' x 100' or as required by site conditions.
   2. Thickness: Manufacturer's standard.

C. Compliance: Materials shall meet or exceed the following standards:
   1. Air Penetration, ASTM E-1677: Type 1 minimum.
   4. Basis Weight, TAPPI T-41D: 2.7 oz./sq. yd.
   7. Surface Burning Characteristics, ASTM E-84: Class A flame spread and Class A smoke developed.

D. Steel Stud Attachments: Provide 1-5/8” long drill-point coated screw attachment with manufacturer’s standard 2” diameter plastic reinforcing disk for anchoring to steel stud construction, 12- to 20-gage, Tyvek Wrap Caps or approved equal.

E. Approved Materials and Manufacturers:
   1. Tyvek CommercialWrap by DuPont, Wilmington, DE, (800) 448-9835, as basis of design.
   2. Green Guard by Pactiv Building Products, (800) 241-4402.
   4. Manufacturers providing materials of same function, performance and quality are acceptable as approved by the Architect prior to bidding.

2.02 MOISTURE/AIR INFILTRATION FLASHINGS

A. General: Self-adhesive, flexible moisture/air infiltration flashing, designed to prevent incidental moisture intrusion around windows and doors in concealed perimeter flashing system.

B. Material: Fiberglass-reinforced membrane coated on both sides with water-resistant polyethylene, backed with an aggressive 3” wide self-adhesive, self-sealing attachment band.
   1. Strip Width: Minimum 6”, use width recommended by manufacturer for specific application(s).
   2. Thickness: 12 mil minimum (membrane); 35 mil minimum (membrane plus adhesive band).
   3. Roll Length: 75’, or manufacturer’s standard.

C. Compliance: Materials shall meet or exceed the following standards:
   1. Water Vapor Permeance, ASTM E-96: Less than 0.30 perms.
   3. Tensile Strength, ASTM D-828: MD - 20 lbs. /inch. CD - 20 lbs. /inch

E. Approved Manufacturers:
   2. StraightFlash and FlexWrap by DuPont, Wilmington, DE, (800) 448-9835.
   3. Manufacturers providing materials of same function, performance and quality are acceptable as approved by the Architect prior to bidding.

F. Sill Seal: Refer to Section 06100, Rough Carpentry.
PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall examine the wall substrates, window and door openings, and other conditions under which air infiltration barrier materials are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Ensure that surfaces of wall sheathing and/or insulation, windows and door frame flanges and other substrate materials are dry and clean, free of dirt, oil, construction debris or other substances that may interfere with adhesion or the system performance.

3.02 INSTALLATION OF AIR INFILTRATION WRAP

A. General: Apply air infiltration wrap materials in strict accordance with the manufacturer's instructions and recommendations.

B. Install air infiltration wrap after wall sheathing has been installed and approved, but prior to installation of exterior doors and windows.

C. Install rolls horizontally beginning at the floor line and moving up the walls. Lap bottom edge minimum 1” below joint at top of foundation.

D. Lap rolls minimum 6” at horizontal seams. Vertical seams shall be lapped 6-12”.

E. Attach membrane with manufacturer-approved anchorages. If staples are used, they must have 1” minimum crown. Secure at 12-18” o.c. along vertical stud lines.

F. Wrap air infiltration membrane down over roof/wall flashing transitions.

G. Cut modified “I” in the membrane at window and door openings. Fold side and bottom flaps into opening and secure. Cut head flap and flip up to expose sheathing, and temporarily secure.

H. Install flexible sill flashing, specified below.

I. Apply continuous bead of sealant along sides (jambs) and across head of rough opening. Position such that window or door frame flange will contact sealant. Do not apply sealant across bottom of opening, to allow moisture to escape.

J. Install windows and/or door frames, specified elsewhere.

K. Install jamb and then head flashings, specified below. Flip down head section of air infiltration wrap and secure with tape.

L. Apply sealant to rear side of window sill sections.

M. Tape all vertical and horizontal seams in wrap.

N. Tape all plumbing, mechanical and electrical fixtures, equipment, piping and conduit protruding through air infiltration wrap.

O. Stucco Air Infiltration Wrap:

1. Shingle stucco wrap over the upper back edge of the lath weep screed for proper drainage.

2. Install stucco wrap with grooved surface pattern running vertically to encourage moisture to drain down to the weep screed.

P. Upon completion of air infiltration wrap installation, inspect wrap for holes, tears and punctures and repair damaged areas. Wrap shall be airtight and free from holes, tears and punctures.

3.03 INSTALLATION OF MOISTURE/AIR INFILTRATION FLASHINGS

A. General: Apply self-adhesive flashing materials in strict accordance with the manufacturer's instructions and recommendations.

B. Installation Sequence:

1. Ensure that air infiltration wrap has been properly installed, cut at window and/or door openings and wrapped through the rough openings, as specified above.

2. Install self-adhesive, flexible strip flashings to sills and lower jambs of window and/or door openings.

3. Apply compatible sealant to back surface of window and/or door frame flanges, and install windows and/or door frames.
C. Peel away release paper and place self-adhesive strip flashings over window and/or door frame sill flanges, then jambs, then heads, extending material beyond the flange opening and lapping materials as recommended by the manufacturer. Apply firm pressure with a metal or wood roller along the entire adhesive strip to ensure continuous seal.

D. Upon completion of installation, inspect strip flashings for gaps, holes, tears and punctures and repair damaged areas. Flashings shall be airtight and free from holes, tears and punctures.

E. Cover installation as soon as possible. Do not leave strip flashings exposed to sunlight longer than recommended by manufacturer.

END OF SECTION
SECTION 07536

THERMOPLASTIC SHEET ROOFING - FULLY-ADHERED

PART 1  GENERAL

1.01  WORK INCLUDED

A. Cleaning of substrate in preparation for roofing and insulation installation.
B. Installation of all insulation and protection boards, unless arranged for otherwise.
C. Furnish and install fully-adhered sheet roofing system.
D. Furnish and install miscellaneous roofing specialties as noted, including parapet flashings, edge flashings and terminations and counter flashings, unless arranged for otherwise.
E. Furnish and install built-up roof drainage crickets, unless provided by roof insulation or decking contractor.
F. Furnish and install walkway protection membrane or pavers.
G. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 06160, Exterior Glass Mat Gypsum Sheathing: Roof cover board.
   3. Section 07210, Thermal Building Insulation.
   4. Section 07220, Roof and Deck Insulation.
   5. Section 07221, Tapered Rigid Insulation.
   6. Section 07621, Galvanized Metal Flashing and Trim.
   7. Section 07720, Roof Accessories.
   8. Division 15, Mechanical.

1.02  QUALITY ASSURANCE

A. Reference Standards:
   2. Applicable Federal Specifications (FS) for materials as specified herein.
   5. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Materials and installation shall comply with applicable standards and recommendations of the Rubber Manufacturers Association and the Single-Ply Roofing Institute (SPRI).
C. Materials shall be supplied and installed by a roofing contractor licensed by the manufacturer or certified by the manufacturer as a qualified installer of the specified products.
D. All work of this Section shall be performed by a single installer, who shall have minimum five (5) years of successful experience with projects of similar size and complexity.
E. Approved Subcontractors:
   1. Blacks Roofing.
   5. Equals as approved by the Architect meeting requirements specified above. Submit qualifications statement listing similar experience with request.
F. Installer shall certify that all roof system materials provided are compatible with the roof system assembly specified and approved by the roof membrane manufacturer for use in this system.
G. Design Criteria: Roof design shall meet the minimum requirements of the Single-Ply Roofing
Institute for the specified roofing system type, unless more stringent requirements are required by the jurisdiction with authority over the project.

1. External Fire Resistance: UL Class A.
2. Internal Fire Resistance: Factory Mutual (FM) Class I.
4. Warranty shall meet wind resistance defined above.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for sheet roofing installation, surface conditioner compatibility, elastic flashings, joint cover sheet and joint and crack sealants, with temperature range for application of roofing membrane.
B. Shop Drawings: Submit shop drawings indicating sheet layout and installation pattern for approval.
C. Warranties: Submit sample warranties, in accordance with the requirements of Section 01740.
D. Design and Specification Approval: Prior to starting roofing, Contractor shall submit a letter certifying that the roofing design and specifications are proper for this particular project.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Weather Conditions: Proceed with elastomeric sheet roofing work only when weather conditions comply with manufacturer's recommendations and will permit materials to be applied and cured in accordance with those recommendations. Do not exceed temperature limitations recommended by roofing manufacturer.
   1. Do not apply sheet roofing during inclement weather or when air temperature is below 40°F.
   2. Do not expose membrane and accessories to a constant temperature in excess of 180°F.
   3. Do not apply sheet roofing to damp, frozen, dirty, dusty or deck surfaces unacceptable to manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver roofing materials, insulation and accessories in manufacturer's protective containers with labels intact and legible, and comply with manufacturer's instructions for storage and handling.
B. Handle rolled goods as required to prevent damage. Store all materials on clean, raised platforms with weather-protective coverings.

1.06 WARRANTIES

A. Provide manufacturer's written 15-year total system warranty covering defects in materials and workmanship, and covering all specified design criteria.
B. Provide manufacturer's written extended 20-year warranty covering defects in materials.

PART 2 PRODUCTS

2.01 ROOF SYSTEM DESCRIPTION


2.02 ROOF INSULATION

A. Membrane roof system supplier and installer shall ensure that roof insulation materials provided are compatible with the roofing system specified and approved by the roof membrane manufacturer for use in this system.
1. Rigid Board Roof Insulation: Refer to Section 07220.
2. Tapered Rigid Roof Insulation: Refer to Section 07221.

2.03 SHEET ROOFING MATERIALS

A. Membrane: Fully-adhered 60 mil thermoplastic membrane, conforming to the following minimum criteria:
   1. Roll Width: 10'-0" wide, or manufacturer's standard width.
   3. Properties:
      c. Specific Gravity: 1.15 +/- .05, ASTM D297.
      d. Hardness: 60 +/-10, ASTM D2240.
      e. Tear Strength: 55 lbf, ASTM D751.
      f. Factory Seam Strength: 25 lbf/in. minimum, ASTM 1876.
      g. Water Vapor Perm: 0.10 maximum, ASTM E96.
      h. Ozone Resistance: No cracks, ASTM D1149.
      i. Puncture Resistance: 300 lbf, FTM 101C Method 2031.
      k. Resistance to Water: Less than 2%, ASTM D471.
      l. Tolerance on Nominal Thickness: +/-10, ASTM D751.
      m. Design Criteria: Refer to paragraph 1.02.G. above.

B. Batten Strips: Manufacturer's standard 1" x 18-gage aluminized steel strapping.

C. Fasteners: Manufacturer's standard corrosion-resistant type, compatible with materials being attached.

D. Fasteners: Manufacturer's standard concrete fastener for mechanically-attached insulation into existing concrete deck.

E. Flashing: 1/16" thick thermoplastic forming flashing as furnished by membrane manufacturer.

F. Bonding Adhesive: Furnished by membrane manufacturer, compatible with all materials to which the membrane is to be bonded.

G. Splicing Cement and Lap Sealant: For sealing the exposed edge of the splices, shall be trowel or gun consistency as furnished by membrane manufacturer.

H. Lap Sealant: Compatible with materials with which it is used, shall be trowel or gun consistency, furnished by membrane manufacturer.

I. Water Cut-Off Mastic: Compatible with materials with which it is used, furnished by membrane manufacturer.

J. Molded Pipe Flashing: Compatible with materials with which it is used, furnished by membrane manufacturer.

K. Nite Seal: Compatible with materials with which it is used, furnished by membrane manufacturer.

L. Pourable Sealer: Compatible with materials with which it is used, furnished by membrane manufacturer.

M. Rubber Nailing Strips and Fasteners: Extruded nailing strips and fasteners furnished by membrane manufacturer.

N. Primer: None required.

O. Approved Manufacturer:
   1. VersiWeld by Versico, Carlisle, PA, (800) 992-7663.
   2. Manufacturers providing materials of same function, design and performance are acceptable, only as approved by the Architect prior to bidding.
PART 3 EXECUTION

3.01 INSPECTION

A. Installer shall thoroughly examine surfaces and substrates to receive fully-adhered sheet roofing materials prior to commencing work. Report in writing to the Contractor any condition that may potentially affect proper application or warranty. Do not commence work until such defects have been corrected to the satisfaction of the Roofing Subcontractor. Beginning work shall be considered acceptance of surfaces.

B. Ensure that drains, sleeves and curbs which pass through surfaces to receive roofing are rigidly installed.

C. Ensure flatness and tightness of joints in deck sheathing.

1. Test pullout capacity of mechanical fasteners in the presence of the roofing manufacturer's technical representative if required by the manufacturer as a condition of the warranty.

D. Ensure that surfaces are free of cracks, depressions, waves or projections which may be detrimental to the successful installation of sheet roofing. Remove foreign materials.

E. Construction Waste Management and Disposal: Manage construction waste in accordance with provisions of Section 01714.

3.02 INSTALLATION OF SHEET ROOFING

A. Install rigid or tapered rigid insulation in accordance with roofing manufacturer's written instructions and recommendations and as specified in Section 07220 and 07221.

B. Install cover board over rigid board roof insulation in accordance with roofing manufacturer’s written instructions and recommendations, if specified. Refer to Section 06160 or 07220.

C. Install fully-adhered single-ply sheet roofing in accordance with the manufacturer’s specifications, written instructions and the following requirements:

1. Loosely lay sheet membrane over roof insulation. Allow membrane to relax minimum thirty (30) minutes before adhering or splicing.

2. Membrane: Apply, lap and splice using methods and materials recommended by the manufacturer. Laps shall run parallel to slope of the roof, unless approved otherwise. Apply adjoining sheets by lapping the edges and splicing. Attach membrane to perimeter edges, nailers and penetrations in accordance with manufacturer's requirements.

3. Flashing: Apply, lap and splice using methods and materials recommended by the manufacturer. Flash around penetrations using factory prefabricated pipe seals where possible. Field fabricated seals may be used where necessary using manufacturer's standard details.

D. Installation shall be performed by a roofing contractor licensed by the manufacturer.

E. Adhesive apply sheet roofing to perimeter edges, lay seam edges 3” and seal. Seal sheet roofing with 3” lap where metal collars or flanges are required.

F. Apply isolating sections for roof control/expansion joints.

G. Apply sealant in accordance with manufacturer's instructions. Seal ends and edges to each other and to adjoining surfaces with uniform fillet bead of sealant.

H. Flash and seal watertight any items projecting through membrane with counterflashing membrane material.

1. Provide and install prefabricated sheet metal boots at all pipe vents and other roof penetrations. Solder joints as specified in Section 07621.

I. Apply precut disks of sheet roofing material to cover and protect fasteners in the field.

3.03 TESTING

A. Contractor shall perform a flood test for the watertightness of the roof membrane. The test shall be conducted in the presence of the Owner's principal representative and the Architect.

3.04 FIELD QUALITY CONTROL
A. Inspection: A representative of the manufacturer shall make an inspection upon completion to ascertain that the entire system has been installed according to the manufacturer’s specifications and details. Written letters of acceptance shall be sent to the Owner’s principal representative and the Architect.

3.05 CLEANING AND PROTECTION

A. Upon completion, remove surplus materials and debris from the site.
B. Remove excess adhesives or other materials from adjacent surfaces, including metal surfaces of flashings and rooftop equipment.

END OF SECTION
SECTION 07610

PREFINISHED MECHANICALLY-SEAMED METAL ROOFING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install prefinished non-ventilated soffit systems, complete with all associated attachments and trims.
B. Furnish and install prefinished metal fascia, complete with all associated attachments and trims.
C. Furnish all equipment required for field forming and cutting operations of the prefinished metal system.
D. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 07621, Galvanized Metal Flashing and Trim.
   3. Section 07900, Sealants and Joint Fillers.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   2. NAAMM: Metal Finishes Handbook.
   5. ASTM A446: Hot-Dipped Galvanized Steel.
   6. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Manufacturer Qualifications: Prefinished roofing material shall be by a manufacturer who has fabricated metal roofing systems of the specified type, quality and performance for a minimum of ten (10) years.
C. Installer Qualifications: Installation shall be by an installer with minimum of five (5) years successful experience on projects of similar scale and complexity.
   1. Certification: Installer shall be a manufacturer-certified installer, and provide copy of such certification as specified in paragraph 1.03 below.
D. Manufacturer shall ensure the compatibility of all components, accessories and equipment that are part of the fabrication of the roofing and the overall quality and reliability of the system.
E. Design Criteria:
F. Manufacturer will provide a field representative for on-site inspection of the components to ensure that the installation is complete and weathertight and meets the factory quality control requirements of the manufacturer and as specified in this Section.

1.03 SUBMITTALS

A. Product Literature: Submit manufacturer’s written product literature and specifications illustrating the proposed roofing materials and components showing compliance with the requirements of this Section.
B. Shop Drawings: Submit shop drawings indicating proposed panelization of the soffits and fascias, fabrication and mechanical-seaming details, trims, closures and accessories, and installation details and instructions.
C. Samples: Submit samples of manufacturer’s full line of prefinished metal textures and colors for
selection by the Architect.

1. Submit sample of soffit system, minimum 12" x 12", illustrating typical mechanically-seamed standing seam or batten cap condition.

D. Installer Certification: Submit manufacturer’s letter or certificate demonstrating certification by the manufacturer.

1.04 DELIVERY, STORAGE AND HANDLING

A. Installer shall coordinate the delivery schedule for the roofing systems with the Contractor to assure that all roof and wall substrates are properly prepared when the components are delivered to the site.

1.05 TESTING

A. Manufacturer shall submit negative load test performed by an independent testing laboratory in accordance with ASTM E330-70 (Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors under the Influence of Wind Loads). When tested in multiple spans of three (3) or more sections, the .032" roofing material shall span 5'-6" and withstand a negative load of 40 psf without damage; .040" roofing/siding material shall span 6'-8" and withstand a negative load of 50 psf without damage.

B. Seals between pans shall be affected such that at 18 psf static pressure, air infiltration shall not exceed .012 cfm/sq. ft. Manufacturer shall submit air infiltration tests performed by an independent testing laboratory in accordance with ASTM E283.

1.06 WARRANTIES

A. Provide manufacturer’s written one-year warranty covering defects in materials and workmanship, including installation on the site.

B. Provide manufacturer’s standard 20-year warranty covering failure of the specified finish.

PART 2 PRODUCTS

2.01 PREFINISHED METAL SOFFIT

A. General: Prefinished metal soffit shall be factory fabricated, rolled and finished for delivery to the site. System shall include all closure, sill, rake, jamb and miscellaneous trims and accessories necessary for a complete and weathertight installation.

1. Soffit Type: Non-vented, ribbed panel with concealed fasteners.

B. Materials: 24-gage minimum or .032" aluminum alloy, 3004 coil stock.


2. Finish: Prefinished by manufacturer Kynar 500 fluorocarbon coating, minimum 1 mil thick consisting of a prime coat and a finish coat.

3. Color: The Architect shall select color from the manufacturer’s full line of standard prefinished colors. Color may vary from prefinished roofing and siding.

C. Fabrication: Roll-form manufacturer’s prefinished coil stock to product finished, exposed pan width of 12" maximum, ribbed at 4" on center.

1. Panelization of soffit shall be as shown on the Drawings, unless otherwise approved. Factory fabricate to the greatest extent possible.

2. Cleats: Fabricated to be interlockable.

3. Form pans to run full length from eave to building without joints.

4. Hem exposed edges on underside 1/2". Miter and seam corners.

D. Installation Type: Interlocking.

E. Fasteners: All fasteners shall be aluminum, steel or same material as the prefinished roofing and siding.
shall be concealed, except as shown on the Drawings.
F. Approved Manufacturers:
1. Series E-375 by Englert, Denver, CO, (303) 288-8070 or preapproved equal.
2. Manufacturer must be compatible with prefinished metal roofing and siding manufacturer. See approved manufacturers in paragraph 2.01.B.

2.02 ASSOCIATEDFLASHINGS AND TRIMS
A. Contractor shall coordinate the furnishing of associated fascias, flashings and trims specified in other Sections for exposed locations with the work of this Section. Such work shall be by the same manufacturer/installer as the prefinished metal roofing to the greatest extent possible.
B. Gage: Provide the following minimum gages for accessory materials:
1. 22-gage for vertical fascias. Provide 1/2" hemmed edge as shown on the Drawings.
2. 24-gage for other miscellaneous trims not specified for other gages.

2.03 FABRICATION
A. General: Prefinished metal soffit system shall be factory fabricated, rolled and finished for field forming, installation and seaming.
B. Pan Edges: All exposed edges, including pan edges at valleys, shall have edges hemmed 1/2" minimum.

2.04 FIELD EQUIPMENT
A. Installer shall furnish and maintain all site-based cutting, forming and seaming equipment as necessary to fabricate and install all metal roofing, flashings, accessories and trim for a complete and weathertight installation.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION
A. Installer shall examine the substrate and the conditions under which metal soffit work is to be performed and notify the Contractor in writing of unsatisfactory conditions which would prevent the successful completion of this work. Do not start work until unacceptable conditions have been corrected in a manner acceptable to the Installer.
B. Installer shall be responsible for ensuring delivery of the prefinished materials and roll-forming equipment to the site, as specified in paragraph 1.04.
C. Installer shall coordinate the work of this Section with other contractors and equipment suppliers as required for a complete and weathertight installation.
D. Ensure that substrate is sound, dry, properly sloped for drainage and securely anchored in position.
E. Ensure that proper subframing and/or blocking has been installed as required for installation of the prefinished soffit and fascia systems.
F. Ensure that adjacent work of other trades has been completed and approved prior to beginning work, to the greatest extent possible.

3.02 INSTALLATION OF PREFINISHED METAL SOFFIT
A. General: Field fabrication and installation shall be done in accordance with all applicable building codes, standards and the written instructions and recommendations of the manufacturer of the approved prefinished metal soffit. Soffit shall be anchored firmly into position, forming a completely watertight and weathertight installation.
1. **Field Fabrication Details:** All aspects of field rolling, cutting and installation processes shall be in strict accordance with the manufacturer’s instructions and recommendations, including but not limited to, the following:
   a. Fascias.
   b. Transition flashings.
   c. Drip edge flashings.
   d. Eave and rake edge flashings.

2. Fabricate and install prefinished metal roofing to allow for expansion and contraction of all components and assemblies without compromising the structural capacity or weathertightness of the system.
   
   **B.** SMACNA Architectural Sheet Metal Manual specifications shall govern for material and workmanship not otherwise specified herein.
   
   **C.** Prefinished Fascia: Install fascia in sections using longest possible length pieces. Miter external corners.
   
   **D.** Prefinished Soffit: Install soffit in sections using continuous length pieces. Orient panel ribs parallel to truss tails. Miter intersection of panel ribs at corners in soffit. Follow manufacturer’s requirements for installation. Notify Architect of any discrepancies in manufacturer’s requirements and specified requirements prior to bid.
   
   **E.** Miscellaneous Flashings and Break Metal: Form sheet materials as detailed on the Drawings for miscellaneous flashings, counterflashings and trims.

3.03 **CLEANING AND PROTECTION**

   **A.** Installer shall thoroughly clean installed prefinished roof panels and trim, using only cleaning products recommended by the manufacturer for this application. Cleaning operation shall not mar or abrade the metal finish.

   **B.** Do not permit unnecessary walking on the finished roofing system. Require all personnel to wear rubber-soled shoes when installing or walking on the finished roof.

   **C.** Remove all excess material and scraps from the site.

**END OF SECTION**
PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish and install new galvanized sheet metal reglets, counterflashings, trim and edge flashings, as indicated on the Drawings.
B. Furnish miscellaneous metal flashings to other Sections as required.
C. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 04210, Brick Masonry: Flexible masonry flashings.
   3. Section 07210, Thermal Building Insulation.
   4. Section 07220, Roof and Deck Insulation.
   5. Section 07221, Tapered Rigid Insulation.
   6. Section 07536, Thermoplastic Sheet Roofing - Fully-Adhered.
   7. Section 07900, Sealants and Joint Fillers.
   8. Section 09900, Painting.
   9. Section 10210, Metal Wall Louvers.

1.02  QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements and recommendations of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   2. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Fabrication and installation shall be by manufacturer's personnel or manufacturer approved subcontractor with minimum five (5) years successful experience in projects of similar size and complexity.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's product literature and shop drawings indicating materials, shapes, proposed layout of joints, special details and intersections, and fabrication and assembly details.
B. Samples: Submit manufacturer's standard colors of prefinished flashings for selection by the Architect.
C. Samples: Submit manufacturer's standard profiles of galvanized flashings and trim for selection by the Architect.

PART 2  PRODUCTS

2.01  GALVANIZED METAL FLASHING AND TRIM

A. General: Commercial quality with 0.20% copper, ASTM A525, except ASTM 527 for lock-forming hot-dipped galvanized, standard G90 class finish.
   1. Gages:
a. 24-gage for cap flashings and step flashings.
b. 24-gage for reglets and counterflashings.
c. 22-gage for clips, retainers and other concealed backer materials.
d. 26-gage for concealed edge and drip flashings, valley flashings and other miscellaneous trims not specified for other gages.

2. Finish: Supply sheet metal flashings and trim with manufacturer’s standard galvanized finish. No further field finishing will be performed where unexposed to view in the completed project.

3. Profiles: Specified in paragraph 2.02 below.

2.02 PREFINISHED GALVANIZED METAL FLASHING AND TRIM

A. Prefinished Metal Flashings and Trim: Field-formed material, 22-gage minimum.
   1. Finish: Supply galvanized sheet metal flashings and trim with manufacturer’s standard baked-on enamel finish. Color to be selected by the Architect from manufacturer’s full line of standard colors. All prefinished galvanized metal gutters, downspouts, drip edge flashings, etc. to be same color, unless otherwise noted.

B. Prefinished Galvanized Metal: Commercial quality with 0.20% copper, ASTM A525, except ASTM A527 for lock-forming hot-dipped galvanized: G90 hot-dip galvanized, mill phosphatized.

4. Gages:
   a. 24-gage for cap flashings and exposed step flashings.
   b. 24-gage for scupper flashings.
   c. 24-gage for kick flashings.
   d. 22-gage for clips, retainers and other concealed backer materials.
   e. 24-gage for edge flashings and other miscellaneous trims not specified for other gages.

2. Finish: Supply galvanized sheet metal flashings and trim with manufacturer’s standard baked-on enamel finish. Color to be selected by the Architect from manufacturer’s full line of standard colors.

2.03 ACCESSORY MATERIALS AND COMPONENTS

A. Fasteners: Concealed clip-type of same material as flashings, sized to suit application.

B. Nails: Hot-dipped galvanized steel roofing type.

C. Screws: Hot-dipped galvanized Phillips head, with neoprene washers.

D. Reglets: Fry “MA” Masonry reglet or equal.

E. Chain Downspouts: Galvanized steel chain link with connection accessories; 2-1/4” link width, 1-3/8” link length; 5/16” thickness.

F. Solder and Flux: Type recommended for materials being used.

G. Bituminous Paint: Acid- and alkali-resistant type, black color.


I. Sealant: One (1) component silicone, conforming to FS TT-S-00230, non-staining, non-bleeding, non-sagging, of color suitable for material matching.
   1. Dow 790 or equal.

2.04 FABRICATION

A. Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

B. Form sections in maximum lengths possible. Make allowances for expansion and contraction at joints.
   1. Provide for thermal expansion at 10’ intervals, unless otherwise shown. Use material in longest practical lengths. Sections shorter than 3’-0” will not be allowed.

C. Form stepped flashings as detailed on the Drawings. Provide mitered intersections between
horizontal and vertical sections.

D. Joints and seams exposed to view are to be flat-lock type, except corners, or detailed as flat-butt joints with back-up plate. Open-lap seams are not permitted for joints exposed to view. Fabricate corners minimum 18’ x 18”, mitered, soldered and sealed as one (1) piece. Seal all seams with elastic cement.

E. Wipe and wash clean soldered joints to remove traces of flux immediately after soldering.

F. Hem exposed edges of flashings to underside 1/2”. Hemmed edges shall be straight, square design, unless otherwise shown on the Drawings.

G. Backpaint flashings with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

2.05 FIELD EQUIPMENT

A. Installer shall furnish and maintain any site-based cutting, forming and seaming equipment as necessary to fabricate and install all metal flashings, accessories and trims for a complete and weathertight installation.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall examine the substrate and the conditions under which flashing and trim work is to be performed and notify the Contractor in writing of unsatisfactory conditions which would prevent the successful completion of this work. Do not start work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Coordinate installation of flashings with Contractor for membrane sheet roofing and clay roof tile as required.

C. Coordinate installation of valley and edge/drip flashings with primary and secondary roof underlayments specified in other sections.

D. Coordinate installation of sill flashings with Contractor for masonry veneer.

3.02 INSTALLATION OF GALVANIZED SHEET METAL MATERIALS

A. General: Install flashings, reglets, counterflashings and trim in accordance with manufacturer’s written instructions and recommendations.

1. Ensure adequate clearances for thermal expansion and contraction of fabricated sections of materials.

B. Secure flashings in place using specified fasteners. Use exposed fasteners only in locations approved by Architect. When using exposed fasteners, they are to be of same finish as flashings.

C. Conform to applicable SMACNA details, unless otherwise shown. Consult with Architect as necessary.

D. Install kick flashings at all roof edge or eave conditions adjacent to vertical walls and other conditions requiring diversion of drainage away from a particular point. Coordinate specific conditions with Architect as necessary.

E. Apply sealing compound at junction of metal flashings and asphalt felt flashings.

F. Lock seams and end joints. Fit flashings tight in place. Make corners square, surfaces true and straight in planes and lines accurate to profiles.

G. Counterflash mechanical, plumbing and electrical items projecting through roofing.

1. Mechanical, plumbing and electrical details may be schematic in nature. Install all flashings in accordance with current SMACNA requirements.

2. Refer to the Drawings for any special flashing conditions.

3.03 CLEANING
A. Clean all exposed prefinished galvanized surfaces. Remove smudges and other imperfections using cleaning materials recommended by the manufacturer. Remove excess sealant from prefinished materials and leave installation in clean condition.

B. Advise Contractor of measures to be taken to protect prefinished surfaces from damage during the balance of construction.

END OF SECTION
SECTION 07720
ROOF AND ATTIC HATCHES

PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish and install prefabricated operable roof hatch with integral curb.
B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 05300, Metal Decking.
   3. Section 06100, Rough Carpentry: Framing of hatch openings.
   4. Section 07536, Thermoplastic Sheet Roofing - Fully-Adhered.
   5. Section 09900, Painting.

1.02  QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's product specifications, rough-in diagrams, fabrication details, installation instructions and general product recommendations.

1.04  DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in unbroken factory cartons.
B. Store in a secure location and protect finishes and glazing from damage until installation.

1.05  WARRANTIES

A. Provide manufacturer's standard written 5-year warranty covering defects in materials and workmanship.

PART 2  PRODUCTS

2.01  ATTIC HATCH WITH STEEL LID

A. General: Factory-fabricated, manually operated, exterior single leaf, 16 ga. attic hatch with 12” high integral steel curb and integral counterflashing. See Drawings for locations.
B. Size: 48” x 48” clear opening minimum.
C. Hinge: Manufacturer's standard.
D. Cover: External, 18 ga. Galvanized steel with 1” rigid foam insulation.
E. Latch: Self-latching lock with interior latch release. Lock is to be supplied with mortise cylinder that is keyed per Section 08710.
F. Finish: Electrostatically applied paint from manufacturer's standard colors.
G. Approved Models and Manufacturers:
   1. Model RbS-4x4 by Milcor, Carol Stream, IL, (800) 624-8642.
   2. Manufacturers providing materials of same design, function and performance are acceptable as approved by Architect prior to bidding.

PART 3 EXECUTION

3.01 PREPARATION

   A. Ensure that structural framing and edge angles for curb openings have been properly installed in accordance with manufacturer's requirements.

3.02 INSTALLATION

   A. General: Install prefabricated roof hatches in accordance with manufacturer's written instructions and recommendations.

END OF SECTION
SECTION 07900

SEALANTS AND JOINT FILLERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Clean and prepare joint surfaces.
B. Furnish and install joint backing materials.
C. Furnish and install joint caulking and sealants.
D. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 03300, Cast-in-Place Concrete.
   3. Section 04210, Brick Masonry.
   4. Section 07621, Galvanized Metal Flashings and Trim.
   5. Division 8, Doors and Windows.
   6. Section 09900, Painting: Joints of walls and/or ceilings of dissimilar colors.
   7. Division 15, Mechanical.
   8. Division 16, Electrical.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Installer of sealants and caulking shall have minimum five (5) years of successful experience with projects of similar size and complexity.
C. Installer shall be continuously employed in work of this type.
D. Certification: Manufacturer/Supplier of sealant and accessory materials shall certify that materials supplied are acceptable and appropriate for the materials, substrates and conditions under which sealants are to be installed.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, recommendations and installation instructions for each type of sealant, caulking compound and associated miscellaneous material required. Submit manufacturer's VOC levels for each product.
B. Samples: Submit samples of manufacturer's standard color line for each type of sealant specified for exposed locations for selection by the Architect.
C. Mock-up Sample Panel: Furnish and install sealants as a part of a large-scale mock-up panel for review of material quality and installer workmanship. Repeat until approved by Architect and Owner's representative.

1.04 ENVIRONMENTAL CONDITIONS

A. Do not proceed with installation of sealants under adverse weather conditions or when temperatures are below 40°F or above 100°F. Proceed with the work only when forecasted weather conditions are favorable for proper curing and development of high early bond strength. Where joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in lower third of the manufacturer's recommended installation temperature range so that sealant will not be subjected to excessive elongation and bond stress by subsequent
low temperatures. Coordinate time schedule with Contractor to avoid delay of project.

1.05 WARRANTIES

A. Provide manufacturer’s written 5-year warranty covering defects in materials when such materials are properly applied and fully cured as described in the manufacturer’s product data sheets. The Contractor further agrees to replace sealants which fail because of loss of cohesion or adhesion, or that do not cure properly due to improper application or curing, or when the materials installed are not appropriate for that application, joint type or other factor beyond the manufacturer’s control, for a period of five (5) years.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

A. General: Supplier/Installer of work of this Section shall certify that materials specified and/or furnished for this project are appropriate for use in the specified applications for the following criteria:
1. Compatibility of sealant material with adjacent materials.
2. Compatibility of sealant material with type and degree of weather exposure.
3. Compatibility of sealant material with expected use of space.
4. Compatibility of sealant material with joint type, width and depth.

B. Exterior: One- or two-part polyurethane-based elastomeric sealants complying with FS TT-S-00230, Class A, Type I (self-leveling) or Type II (non-sag).
1. One-Part Sealant: Sonolastic NP-1 by Sonneborne as basis of design or as recommended by manufacturer for type of application.
2. Two-Part Sealant: Sonolastic NP-2 by Sonneborne as basis of design or as recommended by manufacturer for type of application.

C. Interior: One-part silicone-based non-sag, elastomeric sealant, resistant to mildew complying with FS TT-S-01543, Class A, and FF TT-S-00230, Class A.
1. Sonolastic Omniseal and OmniPlus by Sonneborne as basis of design or as recommended by manufacturer for type of application.

D. Interior Paintable: One-part non-sag mildew-resistant acrylic emulsion sealant complying with ASTM C834, paintable.
1. Sonolac by Sonneborne as basis of design or as recommended by the manufacturer for type of application.

E. Concrete Slab Joints: One-part non-priming urethane-based self-leveling pourable sealant complying with FS TT-S-00230C, Class A, Type 1 (horizontal use).
1. Sonolastic SL-1 by Sonneborne as basis of design or as recommended by manufacturer for type of application.
2. Ensure that sealant is compatible with seamless flooring systems specified in Division 9.
3. Ensure that sealant is compatible with special concrete floor finish system specified in Section 09800.

F. Color(s):
1. Colors are to be selected by Architect from manufacturer’s full line of standard colors.
2. Design intent is to match sealant color to color of adjacent material, unless indicated otherwise. The Architect shall have final authority for color selection, including variations from this policy.

G. All sealants are to meet Bay Area Air Quality Management District limits on VOC’s.
1. Architectural Sealant VOC limit: 250 g/L.
2. Sealant Primer (Non-Porous) VOC limit: 250 g/L.
3. Sealant Primer (Porous) VOC limit: 775 g/L.

H. Approved Manufacturers:
2. Tremco Sealants, Cleveland, OH, (800) 321-7906.
4. Manufacturers providing materials of same design, function and performance are acceptable.

2.02 ACCESSORY MATERIALS

A. Primer: Non-staining type for joints as recommended by sealant manufacturer.
B. Joint Cleaner: Non-corrosive and non-staining type recommended by sealant manufacturer, compatible with joint forming materials.
C. Joint Filler: ASTM D1056, round polyethylene foam rod, over-sized 30-50%, as recommended by manufacturer of sealant used.
   1. Provide closed cell or open cell foam rod materials, as recommended by the Installer for specific applications.
D. Bond Breaker: Pressure-sensitive tape recommended by sealant manufacturer to suit application.
E. Joint Fillers for Cast-in-Place Concrete Work: Refer to Section 03100.

PART 3 EXECUTION

3.01 PREPARATION

A. Installer shall examine joint surfaces, backing and anchorage of units forming sealing rabbet and conditions under which sealant work is to be performed and notify Contractor of conditions detrimental to proper completion of the work, performance and curing of sealants. Do not proceed with sealant work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
B. Clean, prepare and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter which might impair adhesion of sealant.
C. Ensure that horizontal and vertical surfaces are of sufficient dimension for required bonding of sealant materials as recommended by the manufacturer.
D. Ensure that sealants are compatible with the substrates to which they are to adhere.
E. Verify that joint shaping materials and release tapes are compatible with sealant.
F. Examine joint dimensions and size materials to achieve required width/depth ratios.
G. Install joint filler to achieve required joint depths to allow sealants to perform properly.
H. Install bond breaker where required.
I. Mask or protect adjacent surfaces which may be marred or damaged by sealant materials.

3.02 INSTALLATION OF SEALANTS

A. General: Install sealant in accordance with manufacturer's instructions. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
B. Tool joints slightly concave in vertical surfaces and flush in horizontal surfaces.
C. Maintain joints free of air pockets, foreign embedded matter, ridges or sags.
D. Ensure that sealant is applied leaving crisp, clean lines with adjacent materials. Do not allow sealant to bleed onto adjacent surfaces. Immediately wipe excess sealant materials off adjacent surfaces.
E. Remove and replace any sealants improperly applied, to the satisfaction of the Architect.
F. Repair and replace any adjacent materials that have been damaged, marred or discolored by work of this Section, to the satisfaction of the Architect.
PART 4 SCHEDULES

4.01 SCHEDULE OF SEALANT WORK

A. Install sealants as indicated on the Drawings or scheduled herein, including but not limited to:
1. Expansion joints in exterior concrete flatwork adjacent to buildings and retaining walls.
2. Expansion joints in exterior concrete pavements, aprons, sidewalks, ramps and curb and gutter sections.
3. Expansion joints and control joints in interior concrete slabs where surfaces are scheduled to be sealed and/or exposed to view.
4. Vertical expansion and control joints in brick masonry walls.
5. Horizontal joints between interior concrete slabs and framed walls.
6. Perimeter of louver and door frames.
7. Perimeter of materials and equipment passing through building walls and roofs.
8. Perimeter joints of metal flashings and accessories.
9. Miscellaneous vertical and horizontal joints between dissimilar materials, where required for contraction and expansion of joints, or where required to maintain the weathertightness of the project.
10. Other joints as indicated, as required for neat appearance, or as directed by the Architect.

END OF SECTION
DIVISION 8 - DOORS AND WINDOWS

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 08110

STANDARD STEEL DOORS AND FRAMES

PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish and install standard hollow metal doors and frames.
B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 03300, Cast-in-Place Concrete.
   3. Section 04210, Brick Masonry: Anchorages.
   4. Section 08710, Door Hardware.
   5. Section 09900, Painting.
   6. Division 15 Mechanical: Mechanical units and louvers installed in hollow metal doors and/or frames.

1.02  QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. SDI-100: Recommended Specifications of Standard Steel Doors and Frames of Steel Door Institute (SDI).
   2. ASTM A366: Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
   4. NFPA 65: Smoke-control door assemblies.
   5. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Manufacturer: Member of Steel Door Institute (SDI).
C. Manufacturer shall comply with all requirements of Underwriters Laboratories where labeled doors and frames are required.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation schedules.
B. Door Schedules: Submit schedule of doors and frames, using same reference marks or numbers for doors and details as that shown on the Drawings.
C. Shop Drawings: Submit shop drawings indicating general construction, configurations, jointing methods, reinforcement and location of cutouts for louvers or glazing.
D. Samples: Submit representative sample of corner section of standard hollow metal doors and frames to Architect for approval. Sample section shall indicate all details of construction and finish.

1.04  DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle all hollow metal doors and frames in a manner to prevent damage and deterioration.
B. Provide packaging, including corner guards, separators, spreaders, banding and, if prefinished, plastic or vinyl wrappings as required to protect all metal doors and frames during transportation and storage.
C. Store doors upright, in a protected area, off the ground, with air space between individual pieces. Protect all finished surfaces.
PART 2 PRODUCTS

2.01 STANDARD HOLLOW METAL DOORS

A. Hollow Metal Doors: Doors shall be cold-rolled, pickled and oiled, stretcher-leveled, all bonderized steel sheets with clean smooth surfaces, complying with Steel Door Institute SDI-100, except as amended in this Section.

1. Type: Composite construction with flush faces and seamless with hemmed edges. Provide insulated doors where scheduled.
   a. Exterior Doors: Grade II, heavy-duty, Model 1, full flush design.

2. Construction: Steel face sheets bonded to 1-3/4” honeycomb or unitized steel core, 14-gage top and bottom channels and 7-gage hinge reinforcement. Provide full urethane core on exterior doors or where scheduled to be insulated door. Furnish the following minimum face sheets:

3. Sizes: As scheduled on the Drawings, 1-3/4” thick, unless otherwise indicated.
4. Style: "Imperial Door" by Ceco as basis of design for insulated core.
5. Finish: Shop-prime as specified below.

B. Door Louvers (where scheduled): Fixed-slat, inverted Y-shape, 18-gage steel frames and core.

1. Sizes: As scheduled on the Mechanical Drawings.
2. Screening: Provide insect screening for louvers in exterior doors only, mounted in frame to interior door face.
3. Style: No. 4634 by Ceco (Leslie Locke Model 8CY).
4. Finish: Shop-prime as specified below.

C. Approved Manufacturers:

2. Curries, Mason City, IA, (515) 423-1334.
5. Manufacturers providing products of same design, performance and function are acceptable as approved by the Architect prior to bidding.

2.02 STANDARD HOLLOW METAL FRAMES

A. Hollow Metal Frames: Frames shall be cold-rolled or hot-rolled, pickled and oiled steel, all bonderized sheets, complying with Steel Door Institute SDI-100, except as amended by this Section. Except where other gages are indicated or specified, fabricate frames from steel not lighter than the following:

1. Exterior Doors: 14-gage.
2. Type: Mitered corners, fully welded frames.
3. Sizes: As shown and scheduled on the Drawings.
4. Finish: Shop-primed as specified below.
5. Silencers: Manufacturer's standard resilient type, minimum three (3) per jamb, equally spaced.
6. Jamb Anchors:
   a. Metal Stud Construction: Stud anchors, four (4) per jamb, securely welded to back of frames.

B. Approved Manufacturers:

1. Ceco Corp., Oak Brook, IL, distributed locally by Ceco Door Division, Fountain, CO, (303) 382-7930.
2. Curries, Mason City, IA, (515) 423-1334.
5. Manufacturers shall be the same as those for hollow metal doors.

2.03 PROFILES

A. Hollow Metal Frames for Doors: Jamb sections shall be standard 2” wide, double-rabbeted, with 7/16” returns, or as shown on the Drawings or required by specified wall construction, except as noted below. Supplier to verify profile specified with wall construction and furnish jamb sections with the required depth to finish around total wall thickness.
   1. Head Sections: Provide 4” head sections for frames where shown or scheduled on the Drawings.

B. Miscellaneous Filler and Closure Shapes: Fully weld to standard profiles and grind smooth as detailed on the Drawings.

2.04 FABRICATION

A. Hollow Metal Doors: Fabricate doors in accordance with Steel Door Institute requirements and recommendations.
   1. Fabricate doors of type, sizes and designs indicated. Provide door clearance of 1/8” at jambs and heads and 5/8” at bottoms. Doors shall have lock edges beveled 1/8” in 2”.
   2. Finished work shall be rigid, neat in appearance and free from defects. Form moulded members straight and true, with joints coped or mitered, well formed and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so they are invisible after finishing.
   3. Mechanically interlock longitudinal seams. Leave seams invisible or weld, fill and grind smooth. Close top and bottom edges of all hollow metal exterior doors to provide a weather seal, provided as part of door construction.
   4. Fabricate exterior doors with face sheets welded to perimeter stiles and inner frame members. Form perimeter frame with continuous one-piece channel at hinge edge, continuous one-piece channel at lock edge and channels at top and bottom. Inner frame members shall be continuous one-piece vertical steel rib stiffeners spaced not to exceed 6” o.c. Face sheets are to be continuously arc welded to perimeter channels. Weld face sheets to interior frame members in manner to provide a door with smooth surfaces. Spaces between stiffeners shall be sound-deadened and insulated full height of door where scheduled.
   5. Reinforce and prepare doors to receive hardware. Refer to Section 08700 for hardware requirements. Mortise, reinforce, drill and tap doors at factory to receive all mortise-type hardware. Provide reinforcing only for doors to receive surface-applied hardware as required. Gages of metal for reinforcing plates shall comply with manufacturer’s recommendations for type of hardware used and size and thickness of doors.
   6. Fill surface depressions with metallic paste filler and grind to smooth uniform finish.
   7. Prepare cutouts for louvers or glazing where scheduled on the Drawings and factory install louvers where possible.
   8. Chemically treat surfaces and apply one (1) coat of primer.

B. Hollow Metal Frames: Fabricate frames in accordance with Steel Door Institute requirements and recommendations.
   1. Form frames of steel to sizes and shapes as detailed. Frames shall be combination-type with integral trim and fabricated with full-welded type construction at joints.
   2. Form frames with full mitered corners and stops, butt T-joints of frames and continuously weld all joints for full depth and width of frame and trim. Close all contact edges tight and dress all welds on exposed surfaces smooth and flush.
   3. Mullions and transom bars shall be closed or tubular construction and shall join with and be secured to heads and jambs with continuous butt-welded joints. Reinforce joints between members with concealed clip angles of same thickness as frame.
4. Finished work shall be strong and rigid, neat in appearance and free from defects. Fabricate moulded members straight and true with corner joints well formed, in true alignment and fastenings concealed.

5. Reinforce and prepare frames to receive hardware. Refer to Section 08700 for hardware requirements.
   a. Prepare frames at factory by templates for installation of specified type hardware. Welding of hinges to frames is not acceptable. Provide frames to receive surface-applied hardware with reinforcing plates only. Provide cover boxes in back of all hardware cutouts.

6. Provide jamb anchors per Steel Door Institute recommendations for type of wall substrate.
   a. Fabricate jambs of frames with dimples for machine bolt anchorage specified in paragraph 2.02 above.

7. Provide floor anchors per Steel Door Institute recommendations for anchoring frame to type of floor construction. Clips shall be adjustable and drilled for two (2) 3/8” anchor bolts.

8. Provide predrilled holes or other attachment or anchorage devices supplied by or required by other Sections.

9. Fill surface depressions of hollow metal frames with metallic paste filler and grind to smooth finish.

10. Chemically treat surfaces and apply one (1) coat of primer as specified below.

2.05 FINISHES

A. Shop-prime by manufacturer using a phosphatized treatment followed by a prime coat paint finish to all surfaces. Clean and chemically treat surfaces to ensure complete paint adherence. Follow with a baked-on coat of rust-inhibitive metallic oxide, zinc-chromate or synthetic resin primer on all surfaces. Air-drying is acceptable when metal is electro-galvanized. Field finishing is specified in Section 09900.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall examine the substrates, wall openings and conditions under which the hollow metal door and frames are to be installed and notify the Contractor of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Contractor shall field verify dimensions and conditions governing the work of this Section prior to beginning fabrication.

C. Contractor shall verify depth of all frames with specified wall constructions prior to fabrication. Notify Architect of any discrepancies or propose required modifications in the shop drawings.

D. For welded frames, provide temporary steel shipping spreaders fastened across bottom of frames. Where construction will permit concealment, leave spreaders in place after installation; otherwise remove spreaders when frames are set and anchored. In place of spreaders, frames may be strapped together in pairs with heads inverted for bracing during shipment. Before shipping, label each frame with metal or plastic tags to show their location, size, door swing and other pertinent information. Number frames to correspond to opening numbers on construction drawings.

E. Ensure that air infiltration wrap has been properly installed and approved prior to beginning installation of the door frames.

3.02 INSTALLATION

A. General: Installation of hollow metal doors and frames is specified in Section 06200, Finish
Carpentry.

B. Install frames and doors in accordance with SDI-100, except as amended in this Section. Remove shipping spreaders, set frames in position, plumb, align and brace securely until permanent anchors are set. Anchor bottom of frames to floors with expansion bolts or with power fasteners. Provide wood spreaders to maintain jamb alignment. Build wall anchors into walls, or secure to adjoining construction as indicated or specified. Where frames require ceiling struts or other overhead bracing, they shall be anchored securely to ceilings or structural framing above, as indicated or as required by site conditions.

C. Frames: Install hollow metal frames plumb and square with maximum diagonal distortion of 1/16". Ensure frames are accurately and rigidly anchored to adjacent construction.

D. Grout all exterior hollow metal frames full with masonry mortar after installation in masonry or concrete construction; foam in insulation in frames scheduled for insulated doors in other construction, and frames in fire-rated assemblies where required by the applicable assembly.

E. Doors: Install hollow metal doors plumb and square with maximum diagonal distortion of 1/16". Install hardware in accordance with requirements of Section 08700 and adjust as necessary for proper operation.

F. After installation, touch-up scratched or damaged surfaces. Use type of primer identical to that used for shop coat.

G. Coordinate installation of glass and glazing in doors, sidelites, and transoms, where scheduled.

H. Coordinate installation of mechanical units or louvers, furnished by Division 15, into hollow metal doors and/or frames, if applicable. Ensure the compatibility of sizes, materials, finishes and anchorages.

I. Doors are to be finished without hardware. Coordinate with painting trades. Masking of hardware is unacceptable.

3.03 PROTECTION AND CLEANING

A. Protect doors and frames from damage during transportation and at site. After installation, protect doors and frames from damage during subsequent construction activities. Damaged work will be rejected and shall be replaced at no additional cost to the Owner.

B. Clean all surfaces of hollow metal doors and frames, and leave prepared for field finishing. Refer to Section 09900, Painting.

END OF SECTION
SECTION 08700

FINISH HARDWARE

PART 1 GENERAL

1.01 WORK INCLUDED
   A. Furnish finish hardware for new exterior doors, other than that specified in specific door Sections.
   B. Related work specified elsewhere:
      1. Section 01600, Material and Equipment: Limitations on substitute products, if applicable.
      2. Section 01714, Construction Waste Management.
      4. Section 08110, Standard Steel Doors and Frames.

1.02 QUALITY ASSURANCE
   A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
      1. BHMA: Applicable standards for finish door hardware.
      2. ANSI A115.2: Door and Frame Preparation for Bored or Cylindrical Locks for 1-3/4” Doors.
      3. ANSI A115.4: Door and Frame Preparation for Lever Extension Flush Bolts.
      5. ANSI A156.1: Butts and Hinges.
      6. ANSI A156.2: Locks and Lock Trim.
      7. ANSI A156.4: Door Controls (Closers).
      8. ANSI A156.6: Architectural Door Trim.
     11. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.03 SUBMITTALS
   A. Hardware Schedule: Submit schedule of each type of hardware required for the Project in accordance with Section 01340, indicating door location, type, quantity required, style, finish and keying group.
      1. Submit copies of the hardware schedule complying with the actual construction progress schedule requirements for each draft. Hardware schedules are intended for the coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.
         a. Format for all schedule submittals to the same method and opening numbers as in this Section and on the Drawings.
      2. Final Hardware Schedule: Based on the hardware requirements indicated, showing complete designation of every item required for each door or opening. Include the following information:
         a. Type, style, function, size, fire rating, degree of swing and finish of each hardware item.
         b. Name, part number and manufacturer of each item.
         c. Fastenings and other pertinent information.
         d. Location of hardware set coordinated with floor plans and door schedule.
e. Explanation of all abbreviations, symbols and codes contained in the schedule.
f. Mounting locations for hardware.
g. Door and frame sizes and materials.
h. List of manufacturers used and their nearest representative with address and phone number.
i. Keying information.

3. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other work (such a hollow metal frames) which may be critical in the project construction schedule.

4. Furnish final draft of schedule after samples, manufacturer’s data sheets, coordination with shop drawings for other work, delivery schedules and similar information has been completed and accepted.

B. Key Schedules: Prepare keying schedules for approval, and key locks in accordance with approved schedule. Furnish in triplicate, complete schedule of key marking and master key system to Architect prior to final acceptance. Furnish three (3) typed copies of keying and programming schedule to the Architect.

C. Samples: Upon request, submit samples of each type of hardware in finish indicated. Samples are to remain undamaged and in working condition through submittal and review process. Items will be returned to the supplier or incorporated into the work with limitations of keying coordination requirements.

D. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory prepared for the installation of hardware. Upon request, check the shop drawings of such other work to confirm that adequate provisions are made for the proper installation of hardware.

1.04 KEYING

A. Provide two (2) change keys for each lock.

1.05 HARDWARE FUNCTIONS – CYLINDER LOCKS (BHMA)

A. F-75 (410) Passage Latch: Latchbolt operated by knob from either side at all times.
B. F-76 (420) Privacy Lock: Latchbolt operated by knob from either side. Outside knob locked by push button inside and unlocked by emergency key from outside or rotating knob from inside.
C. F-81 (451) Office or Entry Lock: Deadlocking latchbolt operated by knob from either side, except when outside knob is locked by turn button in inside knob. When outside knob is locked, latchbolt is operated by key in outside knob or by rotating inside knob. Turn button must be manually rotated to unlock outside knob.
D. F-84 (455) Classroom Lock: Deadlocking latchbolt operated by knob from either side, except when outside knob is locked, latchbolt is operated by key in outside knob or by rotating inside knob.
E. F-86 (457) Storeroom/Utility Space Door Lock: Deadlocking latchbolt operated by key in outside knob or by rotating inside knob. Outside knob is always fixed.
F. F-91 Door Locks: Deadlocking latchbolt operated by key from both sides.
G. Deadlocks:
   1. E-2141: Deadbolt operated by key from either side. Bolt automatically deadlocks when fully thrown.
   2. E-2151: Deadbolt operated by key from outside and turn button or lever from inside. Bolt automatically deadlocks when fully thrown.

1.06 HARDWARE FUNCTIONS – MORTISE LOCKS (BHMA)

A. F01 Passage Latch: Latchbolt retracted by lever or knob from either side at all times.
B. F04 Office and Inner Entry Lock: Latchbolt retracted by lever or knob from either side unless outside is made inoperative by key outside or by rotating inside turn piece. When outside is locked, latchbolt is retracted by key outside or by lever or knob inside. Outside lever or knob
remains locked until thumbturn is returned to vertical or by counter clockwise rotation of key. Auxiliary latch deadlocks latchbolt when door is closed.

C. F05 Classroom Lock: Latchbolt retracted by lever or knob from either side unless outside is locked by key. Unlocked from outside by key. Inside lever or knob always free for immediate exit. Auxiliary latch deadlocks latchbolt when door is closed.

D. F07 Storeroom Lock: Latchbolt retracted by key outside or by lever or knob inside. Outside lever or knob always in operative. Auxiliary latch deadlocks latchbolt when door is closed.

E. F20 Entrance Lock: Latchbolt retracted by lever or knob from either side unless outside is locked by 20° rotation of thumbturn. Deadbolt thrown or retracted by 90° rotation of thumbturn. When locked, key outside or lever or knob inside retracts deadbolt and latchbolt simultaneously. Outside lever or knob remains locked until thumbturn is restored to vertical position. Throwing deadbolt automatically locks outside lever or knob. Auxiliary latch deadlocks latchbolt when door is closed.

F. F12 Dormitory/Exit Lock: Latchbolt retracted by lever or knob from either side. Deadbolt thrown or retracted by key outside or inside thumbturn. Throwing deadbolt locks outside lever or knob. Rotating inside lever or knob simultaneously retracts deadbolt and latchbolt and unlocks outside lever or knob.

G. F14 Store/Utility Room Lock: Latchbolt retracted by knob or lever from either side. Deadbolt extended or retracted by key from either side.

H. F21 Dormitory/Bedroom Lock: Latchbolt retracted by knob or lever from either side. Deadbolt extended or retracted by key outside or thumbturn inside.

I. F15 Hotel Lock: Latchbolt retracted by key outside or by lever or knob inside. Outside lever or knob always fixed. Deadbolt thrown or retracted by inside thumbturn. When deadbolt is thrown, “DO NOT DISTURB” plate is displayed and all keys become inoperative except emergency or display keys. Turning inside lever or knob retracts both deadbolt and latchbolt simultaneously. Auxiliary latch deadlocks latchbolt when door is closed.

1.07 OTHER STANDARDS

A. Hardware Brands: All locks and latchsets must be one brand, all overhead door closers one brand, all floor checks one brand, all hinges one brand, all panic devices one brand.

B. Closers: All closers shall be adjusted to operate with the minimum amount of opening force and still close and latch the door.

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

D. Fasteners:
1. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
2. Furnish screws for hardware installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of other such work as closely as possible, including “prepared for paint” in surfaces to receive painted finish.

E. Suppliers:
1. A recognized builders hardware supplier who has been furnishing hardware in the Denver-Metro area for a period of not less than three (3) years, and who is, or employs, an experienced AHC certified hardware consultant who is available at reasonable times during the course of the work, for consultation about the project's hardware requirements.
2. Hardware supplier must be an authorized factory distributor of all products specified.

F. Hardware Installer: Company specializing in the installation of commercial door hardware with five (5) years documented experience.

G. Pre-Installation Conference:
1. Before hardware installation, General Contractor/Construction Manager will request a seminar be conducted on the installation of hardware; specifically that of locksets, closers
and exit devices. Conduct conference at Project site to comply with requirements in Division 1. The hardware supplier and the representative of the lock, closer and exit device manufacturers shall present the seminar. The seminar is to be held at the jobsite and attended by installers of hardware for aluminum, hollow metal and wood doors. The seminar shall address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation videos.

2. When any electrical hardware is specified, this meeting shall also include the following trades/installers: Electrical and Security Contractors.
   a. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades. Review sequence of operation for each type of electrified door hardware.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment and facilities needed to make progress and avoid delays.

4. Supplier shall notify participants at least five (5) working days before meeting.

5. Failure to hold the pre-installation conference may affect the product warranty.

6. Record discussion and provide copy to each participant.
   a. Comply with the requirements of Section 01200.

1.08 DELIVERY, STORAGE AND HANDLING

A. General Contractor to provide secure lock-up for hardware delivered to the project, but not yet installed. Control the handling and installation of hardware items which are not immediately replaceable, so that the completion of work will not be delayed by hardware losses, both before and after installation.

B. Packaging of hardware is the responsibility of the Supplier. As material is received by the hardware supplier from the various manufacturers, sort and repackage if necessary, in containers marked with the hardware set number. Two or more identical sets may be packed in the same container.
   1. No keys, other than construction master keys and/or temporary keys, are to be packed in boxes with the locks.
   2. Hardware supplier shall apply an easily identified separate label to each carton identifying clearly in large lettering, the hardware group, door number, door location, product number and hand of door.

C. Inventory hardware jointly with representatives of the hardware supplier and the hardware installer until each is satisfied that the count is correct.

D. Coordinate hardware with other work. Tag each item or package separately, with identification related to the final hardware schedule, and include basic installation instructions in the package.

E. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

1.09 WARRANTIES

A. Furnish two (2) copies of the following written warranties and insert in each maintenance manual:
   1. Mechanical failure of door closers for ten (10) years.
   2. Mechanical failure of locksets for seven (7) years.
   3. Mechanical failure of exit devices for five (5) years.
   4. Failure of parts of all other hardware for two (2) years.

1.10 MAINTENANCE

A. Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance, and removal and replacement of builders hardware.

B. Furnish copies of maintenance manuals covering finish hardware for this project complying with the
requirements of Section 01730. Include printed sheets from hardware manufacturers, bound in a 3-ring binder and properly indexed. Manuals to include the following items:
1. Approved hardware schedule, catalog cuts and keying schedule.
2. Hardware installation and adjustment instructions.
3. Manufacturer's written warranty information.
4. Wiring diagrams, elevation drawings and operational descriptions for all electronic openings.
C. Include name, address, phone number of hardware supplier, maintenance instructions and parts list for each type of operating hardware including locks, exit devices and closers.

PART 2 PRODUCTS

2.01 FINISH HARDWARE
A. General: Furnish hardware items in accordance with the hardware schedule following the end of this Section and as indicated in the door schedule. Schedule is intended as a guide to indicate hardware functions. Provide all items needed for door function including fire-rating and labeling requirements for fire-rated doors.
1. Conform to ANSI/BHMA A156 except as otherwise indicated.

2.02 HINGES
A. General: Provide five-knuckle, bottom tip, full mortise template type with non-rising loose pins and ball oriolite bearings, unless otherwise noted.
B. Exterior Doors: Not less than four ball-bearing, non-ferrous, 0.180" or 0.190" gage hinges with non-removable pins or non-rising loose pins with security set screw.
1. Doors up to and including 36" width: 4.5" x 4.5" hinges.
2. Doors over 36" width: 5" x 4.5" hinges.
C. Number of Hinges:
1. Minimum of three (3) hinges per door leaf for doors 84" or less in height.
2. One (1) additional hinge for each 24" of additional height.
D. Approved Manufacturers:
1. Hager.
2. Ives.
4. Stanley.

2.03 LOCKSETS/LATCHSETS
A. Commercial Line: Mortise type heavy-duty commercial grade hardware. Supply all locksets with construction cylinders until replaced by Owner with Medeco cylinders at job completion.
1. Approved Manufacturer: Schlage L-Series with #03L trim, no substitutes.

2.04 DOOR CLOSERS
A. Provide closers that conform to UFAS requirements.
B. Size of Units: Adjust closers to comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, wind conditions and anticipated frequency of use.
C. Approved Manufacturer: LCN, no substitutes.
2.05 DOOR TRIM, STOPS AND HOLDERS

A. Door Stops: Locate in position to permit maximum door swing but not to present a hazard or obstruction.
B. Push/Pull Units and Kickplates: Include manufacturer’s standard exposed fasteners, except through-bolted push/pull units for matched pairs, but not for single units.
C. Trim Plates: .050” in thickness.
D. Protection Plates (Armor, Kick or Mop): Minimum 2” less than door width on stop side and minimum 1/2” less than door width on pull side.
E. Thresholds: Height and slope shall conform to ANSI A117.1 and UFAS requirements. Equip all exterior openings with flat corrugated thresholds, with abrasive surfaces.
F. Approved Manufacturers:
   1. Hager.
   2. Trimco.
   3. Rockwood.
   4. Quality.
   5. Master Manufacturers, Inc.
   6. Glynn Johnson
   7. Ives
   8. Approved equal.

2.06 DOOR STRIP UNITS

A. Continuous Weatherstripping: Provide at each edge of every exterior door leaf.
B. Fasteners: Manufacturer’s standard exposed fasteners for door trim units (kickplates, edge trim, viewers, knockers, mail drops and similar units). Provide non-corrosive fasteners as recommended by manufacturer for application indicated.
C. Weatherstrip and Smoke Seals: Silicone rubber seal; vinyl not acceptable.
D. Approved Manufacturers.
   1. Pemko.
   2. Reese.
   4. Master Manufacturers, Inc.
   5. National Guard.
   6. Approved equal.

2.07 KEYS AND KEYING

A. Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.
B. Provide keyed construction cores and keys for doors as required during the construction period. Construction control and operating keys and core shall not be part of the Owner’s permanent keying system or furnished in the same keyway (or key section) as the Owner’s permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.
C. Cylinders (Interchangeable Core System).
D. Permanent Keys and Cores: Furnished and installed by the Owner.
E. The Owner, or the Owner’s agent, will install permanent cores and return the construction cores to the hardware supplier. Construction cores and keys remain the property of the hardware supplier.
F. Keying Schedule: Arrange for a keying meeting and programming meeting with the Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware are functionally correct, and keying and programming complies with project requirements.
2.08 FINISHES

A. Provide hardware in US26D Satin Chrome finish at all door assemblies.
B. Coordinate all the various manufactured items furnished for the project to ensure an acceptable uniform finish.

PART 3 EXECUTION

3.01 EXAMINATION OF DOORS AND FRAMES

A. The General Contractor, in conjunction with the hardware installer and supplying distributor, shall examine doors and frames as follows:
   1. Examine doors and frames with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance. Ensure that walls and frames are square and plumb before hardware installation.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.
   3. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION OF HARDWARE

A. Perform installation under Section 06200 as specified herein.
B. Mount hardware units at heights recommended in "Recommended Locations for Builder's Hardware" by DHI for standard steel frames or custom steel frames as applicable, except as otherwise specifically indicated or required to comply with governing regulations, including handicapped accessibility.
   1. Mount hardware in accordance with ICC/ANSI A117.1 and UFAS.
C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage, reinstallation or application of surface protections with finishing work of finish installers specified in Division 9 sections. Do not install surface-mounted items until finishes have been completed on the substrate. NOTE: NO POWER-DRIVEN TOOLS SHALL BE USED FOR INSTALLATION OF LOCKSETS ON DOORS.
   1. Installer may leave hardware items in place during finishing work provided such items are fully masked and protected. Remove finish materials which may penetrate masking, without damage to hardware or its finish or replace as required.
D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation. Drawings typically depict doors at 90 degrees; doors will actually swing to maximum allowable degree of swing.
E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
   1. Mount closer on interior room side.
   2. Through-bolt mount overhead holders on all doors unless otherwise approved by the Owner.
F. Cut and fit threshold and floor covers to profile of door frames. Use single piece units.
G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel which will not corrode in contact with the threshold metal.
H. At exterior doors, and elsewhere as indicated, set each edge of threshold in a seal strip of butyl rubber sealant or polyisobutylene mastic sealant to completely fill concealed voids and exclude moisture. Do not plug drainage or weep holes. Remove excess sealant.
1. **VOC Content:** Limit VOC content to not more than 250 g/L for all sealants, backer rods, tapes and cleaners used at interior locations. Limit VOC content to not more than 250 g/L for primers used in non-porous substrates and to not more than 775 g/L for primers used in porous substrates.

2. Joint sealers formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure), fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their components are not acceptable.

3. Do not use joint sealers containing the following:
   a. Mercury.
   b. Butyl rubber.
   c. Neoprene.
   d. SBR (styrene butadiene rubber).
   e. Nitrile.

### 3.03 ADJUST AND CLEAN

**A. General:** Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite type if no other recommended).

1. Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made. Hardware supplier shall make final check and adjustment of locks, closers and other items requiring fine adjustment.

**B. Final Adjustment:** Wherever hardware installation is made more than one (1) month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area.

1. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

**C. Instructions:** Instruct Owner’s personnel in proper adjustment and maintenance of hardware, usage of electronic equipment and hardware finishes during the final adjustment of hardware.

**D. Final Inspection:** Prior to final inspection, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and inspect hardware to ensure proper function of doors and hardware. Consult with and instruct Owner’s personnel in recommended additions to the maintenance procedures. Replace hardware items that have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems in the performance of the hardware.

### 3.04 CONSTRUCTION WASTE MANAGEMENT

**A.** Manage construction waste in accordance with provisions of Division 1. Submit documentation to satisfy the requirements of that Section.

### 3.05 HARDWARE SCHEDULE

**A.** Hardware supplier is responsible for handing and sizing all products as listed in the hardware heading. Quantities listed are for each pair of doors, or for each single door.
### PART 4 SCHEDULE

#### 4.01 HARDWARE GROUPS

**MANUFACTURERS:**
- GL = GLYNN JOHNSON
- IV = IVES
- LC = LCN
- SC = SCHLAGE
- ST = STANLEY

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<tr>
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<th>Manufacturer</th>
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<td>US28</td>
<td>ST</td>
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<td>SB453-12-TB</td>
<td>US26D</td>
<td>IV</td>
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<td>SC</td>
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<td>4041 S-CUSH</td>
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**END OF SECTION**
DIVISION 9 - FINISHES

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
SECTION 09260

GYPSUM WALLBOARD

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install interior gypsum wallboard materials, adhesives, accessories and trim.
B. Tape and finish joints of gypsum wallboard.
C. Texture and finish gypsum wallboard surfaces to the level specified.
D. Related work specified elsewhere:
   1. Section 05400, Light-Gage Steel Framing.
   2. Section 06100, Rough Carpentry.
   4. Section 06200, Finish Carpentry.
   5. Section 07270, Air Infiltration Barriers.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements and recommendations of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   5. ASTM C1396, Standard Specification for Gypsum Board.
   10. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Install gypsum wallboard in accordance with applicable Gypsum Association (GA) publications, including but not limited to:
C. Certifications: Manufacturer shall certify that materials supplied under this Section contain no asbestos.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s written product literature for all gypsum wallboard materials and accessory products specified or required for Project conditions.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in original unopened packages, containers or bundles with labels intact bearing type, sizes and thicknesses, brand name and name of manufacturer.
B. Handle wallboard carefully to avoid abrading surfaces or edges.

C. Store materials flat, under cover, on level platforms, with edges, ends and surfaces properly protected from weather, undue sagging and damage.

D. Protection During Construction: Contractor shall adequately protect all gypsum wallboard materials, wall and roof/ceiling assemblies during construction from weather and moisture penetration, when these materials are installed prior to the structure being enclosed and "dried-in". Also refer to paragraph 3.01 below.

1.05 ENVIRONMENTAL CONDITIONS

A. Maintain ambient temperatures at not less than 55°F for the period of 24 hours before drywall finishing, during installation and until compounds are dry.

PART 2 PRODUCTS

2.01 GYPSUM WALLBOARD

A. General: Provide gypsum wallboard materials in 48" widths complying with FS SS-L-30D.

B. Fire-Rated Gypsum Wallboard:
   1. UL-rated, Type "X", 5/8" thick, maximum permissible lengths, tapered edges.

C. Approved Manufacturers:
   1. American Gypsum, Gypsum, CO, (800) 545-6302.
   2. Manufacturers providing materials of same function and performance are acceptable.

2.02 GYPSUM WALLBOARD ACCESSORIES

A. General: Provide gypsum wallboard accessories in accordance with GA 216.

B. Corner Beads and Edge Trim: Manufacturer's standard galvanized steel beaded units with flanges for concealment in joint compound.

C. Shims: 2" wide cardboard or paper drywall shims, for shimming wood or metal stud frame construction.

D. Joint Tape: Perforated or nylon mesh type, as recommended by the manufacturer.

E. Joint Compound and Finishing Systems: ASTM C474 and C475, Type I and Type II, ready-mixed vinyl type for interior use. Use two (2) separate grades: one specifically for bedding tapes and filling depressions, and one for topping and sanding.
   2. Manufacturers providing materials of same function and performance are acceptable.

F. Channels: Refer to Section 09110, Non-Load-Bearing Metal Framing.

G. Fasteners: Screws:
   1. Type W bugle head, lengths as recommended by manufacturer of gypsum wallboard material for installation in wood construction.
   2. Type S bugle head, lengths as recommended by manufacturers of gypsum wallboard material for installation in steel stud construction.

H. Adhesive: Manufacturer-approved drywall adhesive, oil-based.
   1. Formula 38 Drywall and Construction Adhesive, Ohio Sealants, Inc. or equal.

I. Provide auxiliary materials and accessories for gypsum drywall work of the type and grade recommended by the gypsum wallboard manufacturer.
PART 3  EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall examine the wall, ceiling and soffit rough framing, and other substrates to receive gypsum drywall and the conditions under which gypsum drywall is to be installed and notify Contractor of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Ensure that metal stud framing has been properly installed, providing substrates that will permit the gypsum wallboard systems to be installed creating level, smooth and flush surfaces, sharp and straight edges and corners, and plumb and even returns.
   1. Install gypsum wallboard shims where necessary to remove minor variations in framing and to provide finished surfaces of specified levelness and flushness.
   2. Advise Contractor to remove and replace sections of wall, ceiling or soffit framing that cannot adequately be corrected by the installation of shims.

3.02 INSTALLATION OF GYPSUM WALLBOARD

A. General: Install gypsum wallboard in accordance with the manufacturer’s instructions, specifications and applicable Gypsum Association (GA) publications, including but not limited to:

B. Install gypsum wallboard in locations as specified in the Installation Schedule at the end of this Section, or as required by applicable codes or standards.

C. Installation Method:
   1. Gypsum Wallboard for Interior Metal Stud Walls: Screw only.
   2. Gypsum Wallboard for Interior Soffits and Ceilings: Screw only.

D. Treat cut edges and holes in moisture-resistant gypsum wallboard with sealant.

E. Refer to paragraph 3.04 for installation of expansion joints, corner and edge trims, and other miscellaneous trims.

F. Tape, fill and sand exposed joints, edges, corners, openings and fixtures to produce surface ready to receive surface finishes. Feather coats onto adjoining surfaces so that camber is maximum 1/32". Taping, filling and sanding are required at all locations. Apply primer coat prior to texturing.

G. Tolerances: Install, tape and finish all gypsum wallboard surfaces to maintain tolerances required by the referenced standards.

H. Remove and reinstall defective work.

3.03 INSTALLATION OF MISCELLANEOUS TRIMS

A. General: Install specified metal corner, edge and joint trims as specified herein or shown on the Drawings, or where required by field conditions to provide a complete and finished installation.

B. Corner Beads: Place corner beads at all external corners using longest practical lengths, in accordance with the manufacturer’s recommendations.

C. Edge and Miscellaneous Trims: Place edge trim where gypsum wallboard abuts dissimilar materials and at reveals, in accordance with the manufacturer’s recommendations. Wrap all exposed edges of gypsum wallboard with specified edge or reveal trim, unless conditions allow the use of full-size
corner bead trims.

3.04 FINISHING OF GYPSUM WALLBOARD

A. General: Apply texturing in accordance with manufacturer's written instructions and referenced standards. Ensure uniform coverage and appearance, using specified equipment.

B. Specified Level(s) of Gypsum Wallboard Finish: Finishes shall comply with current standards and recommendations of the Gypsum Association (GA) for the finish level(s) specified. Refer to publication GA-214.

1. Level 2: All joints and interior angles shall have tape embedded in joint compound and wiped with a joint knife leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. 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.

a. Locations: Interior wall and ceiling surfaces of the pump station.

3.05 CLEANING AND PROTECTION

A. Remove soil, stains and extraneous materials from adjacent surfaces caused by installation of drywall materials. Remove and replace materials that cannot be satisfactorily cleaned.

B. Leave gypsum wallboard surfaces clean and prepared for further finish work specified in other Sections.

C. Installer shall advise Contractor of required procedures for protection of the gypsum wallboard work from damage and deterioration during the remainder of the construction period.

PART 4 SCHEDULES

4.01 INSTALLATION SCHEDULE

A. Install 5/8” fire-rated gypsum wallboard in the following locations:

1. All interior walls, ceilings and soffits.

END OF SECTION
PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install resilient base.
B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 06200, Finish Carpentry.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. ASTM F 2034: Linoleum Sheet Flooring.
   4. ASTM F 710-86: Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
   5. ASTM F 970-87: Test Method for Static Load Limit.
   9. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Materials shall be free of objectionable odors, blisters, cracks and other imperfections that will reduce wearability and detract from the appearance of the completed installation.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product literature, specifications, and installation instructions for each type of resilient flooring, base, and trim specified.
B. Samples: Submit samples of each type of material specified for the Architect's approval and color selection.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the project site in the manufacturer's original unopened containers, clearly marked to indicate pattern, gage, lot number and sequence of manufacture.
B. Carefully handle all materials and store in original containers at no less than 70°C F for at least 48 hours prior to installation.

1.05 ENVIRONMENTAL CONDITIONS

A. Continuously heat spaces to receive resilient flooring materials to a temperature of 70°C F for at least 48 hours prior to installation whenever project conditions are such that heating is required.
Maintain 70°F temperature continuously during and after installation as recommended by the manufacturer, but for not less than 48 hours.

B. Maintain a temperature of not less than 55°F in areas where work has been completed.

1.06 Warranties

A. Provide manufacturer’s standard warranty covering defects in materials and workmanship, as follows:
1. Miscellaneous Resilient Transitions and Trims: One (1) year.

Part 2 Products

2.01 Resilient Base

A. General: Solid rubber base, Roppe as basis of design.
   1. Thickness: 1/8” nominal.
   2. Size: 4” high throughout x continuous rolls (+/- 120’ length).
B. Surface Finish: Smooth.
C. Style: Coved.
D. Color: To be selected by the Architect from manufacturer’s full line of standard colors.
E. Approved Manufacturers:
   3. Burke Flooring Products, San Jose, CA, (408) 297-3500.
   7. Manufacturers furnishing materials of same design, function, quality and performance are acceptable.

Part 3 Execution

3.01 Inspection and Preparation

A. Installer shall examine the areas and conditions under which resilient flooring work is to be placed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
B. Surface shall be smooth, level and at the required finish elevation without more than 1/8” in 10’ variation from level or slopes shown. Existing conditions in excess of these tolerances are subject to approval by the Architect.
C. Protect adjacent walls and other materials and finishes from damage during installation.

3.02 Installation of Resilient Base

A. General: Install resilient base and transitions in accordance with manufacturer’s written instructions and recommendations. Use appropriate tools for cutting and installation of the base and trim materials.
B. Fit joints tight and vertical. Use of pieces shorter than 24” is not allowed.
C. Internal and External Corners:
   1. Neatly miter cut internal corners.
   2. Use only premolded sections for external corners. Exposed ends of base sections and "birdsmouth" gaps at external corners will not be acceptable.

D. Install base on solid backing. Adhere tightly to wall and floor surfaces with full coating of adhesive. Avoid excess adhesive exposed on wall surface.

E. Scribe and fit to door frames and other obstructions.

F. Install straight and level to variation of 1/8" over 10'.

END OF SECTION
SECTION 09900

PAINTING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Prepare surfaces to receive opaque painted finishes as specified.
B. Finish surfaces as indicated in the schedule at the end of this Section. Generally, the scope of work shall include painting all exposed surfaces, whether specifically noted or not, and certain concealed surfaces, except where materials are prefinished or where intended to remain unfinished as described in paragraph 1.02 below.
C. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Division 15, Mechanical.
   3. Division 16, Electrical.

1.02 WORK NOT INCLUDED

A. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces and duct shafts.
B. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require painting under this Section, except as may be so specified.
C. Materials, fixtures and equipment specified or supplied by the manufacturer as prefinished shall not be painted, unless otherwise indicated in the Schedule at the end of this Section. Materials supplied with factory-applied primer coats shall be field finished by this Section, unless otherwise indicated.
D. Do not paint moving parts of operating units, mechanical or electrical parts such as valve operators, linkages, sensing devices and motor shafts, unless otherwise indicated.
E. Priming or finishing of certain surfaces may be specified to be factory-applied or installer-performed under other Sections.
F. Gypsum wallboard will not be painted.

1.03 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements and recommendations of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Finish work shall be performed only by qualified personnel employed by firms specializing in work of this type, with a minimum of five (5) years successful experience in projects of similar size and complexity.
C. Materials shall be applied with appropriate equipment and tools as specified herein, or as required to provide the specified quality.
D. Coordination of Paint Finishes, Primers and Substrates:
   1. Provide finish coats which are compatible with the prime coats actually used.
   2. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrates.
   3. Upon request, furnish information on the characteristics of the specific finish materials to assure that compatible prime coats are used.
   4. Provide barrier coats over non-compatible primers or remove the primer and reprime as
required.
5. Notify the Architect in writing of anticipated problems in using the specified coating
systems over prime coatings or substrates supplied under other Sections.
E. Certification: Supplier shall certify that all paint materials supplied contain no lead or other toxic
substances.
F. Approved Applicators: Textured acrylic coating applicators shall have completed a factory-approved training session and shall have completed at least two (2) similar projects in the last five (5) years.

1.04 SUBMITTALS
A. Product Data: Submit manufacturer's product literature and specifications to show compliance
with the specified requirements.
B. Materials List: Submit materials list of all items proposed to be provided under this Section.
C. Submit product data sheets and MSDS for each product to be used as required by the USGBC as
proof that each product meets the requirements of either Green Seal's GS-11 or GC-03 documents.
This is a requirement in order to receive the possible one point for Credit 4.2 for Low-Emitting
Materials in the Indoor Environmental Quality section of the Leadership in Energy and
Environmental Design Initiative of the U.S. Green Building Council. The calculation of VOC shall
exclude water and tinting color added at the point of sale.

1.05 DELIVERY, STORAGE AND HANDLING
A. Deliver paint materials in original, sealed and labeled containers bearing manufacturer's name,
type of paint, brand name, color, designation and instructions for mixing and/or reducing.
B. Provide adequate storage facilities to store materials at minimum ambient temperature of 45
°F in a well-ventilated area.
C. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.06 ENVIRONMENTAL CONDITIONS
A. Ensure that surface temperature or the surrounding air temperature is above 40°F before applying
finishes. Minimum application temperatures for latex paints for interior work is 45°F; 50°F for exterior work.
B. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures
above 45°F for 24 hours before, during and 48 hours after application of finishes.
C. Provide minimum 15 footcandles of lighting on surfaces to be finished.

1.07 PROTECTION
A. Adequately protect other surfaces from paint and damage. Repair damage as a result of
inadequate or unsuitable protection.
B. Furnish sufficient dropcloths, shields and protective equipment to prevent spray or droppings from
soiling surfaces not being painted and, in particular, surfaces within storage and preparation area.
C. Place cotton cloths and any material which may constitute a fire hazard in closed, metal containers
and remove daily from the site.
D. Remove electrical plates, surface hardware, fittings and fastenings prior to painting operations.
These items are to be carefully stored, cleaned and replaced on completion of work in each area.
Do not use solvents to clean hardware that may remove permanent lacquer finish.
1.08 MAINTENANCE MATERIALS

A. Contractor shall furnish Owner additional maintenance stock of not less than one (1) gallon of each color of finish coating.
B. Containers are to be tightly sealed and clearly labeled for identification.

PART 2 PRODUCTS

2.01 FINISH MATERIALS

A. Paints, Enamels and Fillers: Type and brand scheduled herein, ready-mixed, except field-catalyzed coatings. Pigments fully ground maintaining a soft paste consistency, capable of readily and uniformly being dispersed to a complete homogeneous mixture. Paints shall have good flowing and brushing properties and be capable of drying or curing free of streaks or sags.
1. Paint materials shall contain no lead or other toxic substances. Refer to paragraph 1.03.c.
2. VOC emissions from paints, primers, block fillers and other coatings must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements. Interior flat paints/primers must not exceed 50 g/L VOC, and non-flat paints/primers must not exceed 150 g/L VOC.
B. Paint Accessory Materials: Linseed oil, shellac, turpentine and other materials not specifically indicated herein but required to achieve the finishes specified, of high quality and approved manufacturer.
C. Color(s) as selected by the Architect from manufacturer's full color selection, unless otherwise indicated. Painter shall prepare samples for the Architect's approval of each paint color selected. Remake samples until approved, at no additional cost to the Owner.
D. Approved Manufacturers: Use the same brand throughout the project for each type of paint material specified:
1. Sherwin-Williams ProGreen 200 (low VOC) Series, as basis of design.
2. Paint: Kwal, Pittsburgh, Diamond Vogel, ICI Dulux, Fuller O'Brien, Benjamin Moore, Kelly Moore and Sophir Morris. Using product lines of same quality, function and performance are acceptable only as approved by the Architect prior to bidding.
3. Stain, varnish and other transparent finishes: Refer to Section 09930.

2.02 APPLICATION EQUIPMENT

A. For application of the specified paint, use only such equipment as is recommended for application of the particular paint by the manufacturer and approved by the Architect, except as limited by paragraph 2.02.C.
B. Prior to use of application equipment, verify that the proposed equipment is actually compatible with the material to be applied and that integrity of the finish will not be jeopardized by use of this equipment.
C. Contractor shall use the following application equipment for the specific condition listed, unless otherwise approved:
1. Hollow Metal Doors and Frames: Spray application only. Brushing or rolling is not permitted.
2. Other areas indicated in paragraph 3.03.

PART 3 EXECUTION

3.01 INSPECTION

A. Subcontractor shall thoroughly examine surfaces scheduled to be painted or finished prior to commencing work. Notify the Architect of any condition that may potentially affect proper
application and final appearance. Do not commence work until such defects have been corrected to the satisfaction of the painting subcontractor. Beginning work shall be considered acceptance of surfaces.

3.02 PREPARATION OF SURFACES

A. General: All preparatory work shall be subject to evaluation and acceptance by the Architect. Painting subcontractor will accept responsibility for the preparation of all surfaces, as specified herein, prior to finishing.

B. The cleaning of all surfaces shall be done with non-toxic, biodegradable products that comply with the California Code of Regulations, Title 17, Section 94509, VOC standards for cleaning products.

C. Ensure that the Contractor has corrected defects in all surfaces which may adversely affect work of this Section, including but not limited to:
   1. Hollow metal doors and frames.
   2. Finish carpentry items.
   3. Welding and other attachments.

D. New Wood Surfaces: Wipe dust and grit from softwood items and millwork prior to priming. Spot coat knots, pitch streaks and sappy sections with sealer. Fill knots, imperfections, nail holes and cracks after primer has dried and sand smooth. Back-prime interior and exterior woodwork.
   1. Back-prime interior woodwork which is to receive paint of enamel finish with enamel undercoat paint.

E. Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse well with clean water and allow the surface to dry completely.

F. Remove surface contamination and oils from galvanized surfaces and wash with solvent. Apply a coat of etching-type primer.

G. Remove grease, rust, scale, dirt and dust from steel, ferrous metal and iron surfaces. Where heavy coatings of scale are evident, remove by wire brushing, sandblasting or any other necessary method.
   1. Clean unprimed surfaces by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring that weld joints, bolts and nuts are similarly cleaned. Prime surfaces as required.
   2. Sand and scrape shop-primed surfaces to remove loose primer and rust. Feather out edges to make touch-up patches inconspicuous. Clean surfaces with solvent and prime surfaces as required.
   3. Back-prime structural steel and ferrous metal surfaces to be in contact with concrete, unless furnished by other Sections.
   4. Ensure that excess weld slag or flux deposits are removed, and that all exposed welds are ground or sanded to specified appearance.

H. Prime top and bottom edges of metal doors with enamel undercoat when they are to be painted.

I. Remove all hardware from doors before painting. Masking of hardware is unacceptable.

J. Schedule painting prior to installation of prefinished materials, specialties, furnishings and fixtures to the extent possible, including but not limited to:
   1. Finish hardware.
   2. Fire extinguisher.
   3. Surface-mounted mechanical and electrical devices such as thermostats, prefinished grilles and diffusers, switchplates and outlet cover plates, etc.

3.03 APPLICATION

A. General: Apply finish materials in accordance with the manufacturer's instructions and recommendations. Ensure that surfaces have been properly prepared and primed prior to application of finish coats.

B. Apply each coat at the proper consistency. Allow each coat of finish to dry before the following
coat is applied, unless directed otherwise by manufacturer. Sand lightly between coats to achieve the required finish.

C. Brush Applications:
1. Brush out and work the brush coats onto the surface in an even film.
2. Finish coats shall be finished by roping the paint, moving from dry to wet areas.
3. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.

D. Spray Applications:
1. Except as specifically otherwise approved by the Architect, confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
3. Do not double back with spray equipment to build up film thickness of two (2) coats in one (1) pass.

E. For completed work, match the approved samples as to texture, color and coverage. Remove, refinish or repaint work not in compliance with the specified requirements.

3.04 PAINTING MECHANICAL AND ELECTRICAL EQUIPMENT

A. General: Painting of exposed equipment, louvers, ductwork, piping, conduits, etc. shall be work of this Section, unless otherwise indicated.
1. Prime and paint all ductwork, piping, conduit and devices to be exposed to view in the completed project, unless prefinished or in concealed areas as defined in paragraph 1.02.
2. Coordinate extent of field finishing of mechanical and electrical equipment with the Architect as necessary.
3. Architect retains the right to require prefinished diffusers, grilles and other mechanical or electrical devices to be field finished, whether or not specifically called for.
4. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars and supports in exposed locations, except where items are plated or covered with a prefinished coating, or where located in mechanical chase spaces. Finish paint primed equipment to color selected.

B. Color Coding: Refer to Mechanical and Electrical Sections for requirements concerning color coding, identification branding of equipment, ducting, piping and conduit, if required.
1. Color code equipment, piping, conduit and exposed ductwork in accordance with requirements indicated.
2. Color banding and identification (flow arrows, naming, numbering, etc.).

C. Remove grilles, covers and access panels for mechanical and electrical systems from location and paint separately.

D. Paint face(s) and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
1. Replace identification markings on mechanical or electrical equipment when painted over or spattered.

E. Do not paint gas meters, electric meters and similar exterior equipment provided by outside utility providers, if not permitted by those agencies. Coordinate requirements with the appropriate Subcontractor prior to painting.

3.05 CLEANING

A. Promptly remove paint from adjacent materials or surfaces as work proceeds where spilled, splashed or splattered.

B. The cleaning of all surfaces shall be done with non-toxic, biodegradable products that comply with the California Code of Regulations, Title 17, Section 94509, VOC standards for cleaning products.

C. During progress of work, keep premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.
D. Place cotton cloths and material which may constitute a fire hazard in closed metal containers and remove daily from the site.
E. Upon completion of work, leave premises neat and clean, to the satisfaction of the Architect.

3.06 QUALITY CONTROL

A. Painted finishes shall be subject to evaluation and approval to the satisfaction of the Architect, including but not limited to, the following characteristics:
1. Consistency and smoothness of surface.
2. Coverage and mil thickness.
3. Color match between adjacent areas.
4. Compliance with approved sample(s).

PART 4 SCHEDULES

4.01 EXTERIOR PAINTING AND FINISHING SCHEDULE

NOTE: MWF indicates minimum wet film thickness which is a per coat measurement in mils thickness. Systems are based on Sherwin-Williams (S-W) or as noted.

A. Exterior Exposed Steel Surfaces:
1. Location: Exposed surfaces of exterior steel, stair components and metal decking.
2. Primer: One (1) coat shop prime or inhibitive metal primer, MWF 3.6 mils.
3. Finish: Two (2) coats alkyd enamel, semi-gloss, MWF 4.4 mils.
5. Color(s): To be selected.
B. Exterior Hollow Metal or Ferrous Metal Surfaces:
1. Location: Hollow metal doors and frames, insulated steel doors, pipe bollards, site signage poles, ornamental fencing, handrails and guardrails.
2. Primer: One (1) coat shop prime or inhibitive metal primer, MWF 3.6 mils.
3. Finish: Two (2) coats alkyd enamel, semi-gloss, MWF 4.4 mils.
5. Color(s): To be selected.
C. Metal Boxes, Conduits and Mechanical Equipment:
1. Location: As shown on the Drawings.
2. Primer: One (1) coat, factory primed.
3. Finish: Two (2) coats acrylic latex, MWF 3.6 mils where not factory finished.
5. Color: To match adjacent surfaces.
D. Soffit and Roof Vents: Prefinished by manufacturer.
E. Louvers: Paint where not prefinished by manufacturer.

4.02 INTERIOR PAINTING AND FINISHING SCHEDULE

A. Interior Hollow Metal or Ferrous Metal Surfaces:
1. Location: Hollow metal doors and frames, insulated steel doors and miscellaneous metals.
2. Primer: One (1) coat shop prime or inhibitive metal primer, MWF 3.6 mils.
3. Finish: Two (2) coats vinyl acrylic, semi-gloss, MWF 4.0 mils.
5. Color(s): To be selected.
DIVISION 10 - SPECIALTIES

Portions of these specifications designated as Bidding and Contract Requirements and Division 1, General Requirements, apply to this Division and all Sections herein.
PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install prefinished architectural metal wall louvers, including but not limited to:
   1. Exterior wall louvers for outside air intake.
   2. Exterior wall louvers for exhaust fan discharge.

B. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Division 15, Mechanical.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. Materials shall be certified by the Air Movement and Control Association, Inc. (AMCA) for air performance and water penetration.
   2. ASTM B221: Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
   3. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for all components or products, including certified test reports of required testing.

B. Shop Drawings: Submit plans and elevations of each section of metal wall louvers specified, including installation details.

C. Samples: Submit samples of manufacturer's standard finishes for selection by the Architect.

1.04 DELIVERY, STORAGE AND HANDLING

A. Do not deliver metal wall louvers to the site until wall panels are fully prepared to accept installation.

B. Maintain protective coverings on all components and finishes until louvers are permanently installed.

C. Protect louvers and finishes from damage during installation and protect adjacent surfaces, finishes and materials from damage during installation of louvers.

1.05 WARRANTIES

A. Provide manufacturer's written one-year warranty covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 WALL LOUVERS (Fixed Blade)

A. Prefinished stationary (fixed) blade extruded aluminum louvers in locations shown on the Drawings.
B. Sizes:
1. Exterior: As shown on the Drawings.
2. Thickness: 6” louvers at brick veneer walls.
3. For openings wider than 60”, use two or more louvers stacked side by side. Mullions are to divide the opening equally.

C. Blade Style: Stationary (fixed), .081 minimum wall thickness, mounted at 37° and 45° slope to the “outside” face. Blades shall be spaced at 4” o.c. or manufacturer’s standard spacing as required for cut-off of sight lines. Provide drain gutters to jambs.
1. Exterior outside air intake louver blades shall have vertical offset “hook” in blades for moisture elimination.
2. Interior return air plenum louver blades shall be smooth, standard profile.

D. Bird Screens: 3/4” x .051” flattened expanded aluminum.

E. Free Air Space:
1. Minimum 1007 FPM air velocity before water penetration.
2. Static pressure drop 0.18 inches w.g. through louver at velocity indicated above.

F. Construction: Fabricate frame and blades from minimum 14-gage (0.081”) extruded aluminum 6063-T52 alloy with reinforcing bosses.

G. Frames: Provide manufacturer’s standard integral head, sill, jamb frames and interlocking vertical mullions at multiple panelized sections.
1. Head sections to have exterior drip lip.
2. Sill sections to have integral water stop.
3. Jamb sections to have returns, acting as a water bar.
4. Heads, sills and jambs to be one-piece structural members with integral caulking slot and retaining bead.
5. Slideable interlocking mullion sections to have provision for expansion and contraction.

H. Anchorage Devices: Manufacturer’s standard concealed or countersunk aluminum or stainless steel fasteners.

I. Finish: Kynar 500 Dark bronze finish.

J. Approved Models and Manufacturers:
2. Manufacturers providing materials of same design, function, performance, quality, and appearance are acceptable.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall inspect the conditions under which work is to installed and notify Contractor in writing of unsatisfactory dimensions or conditions. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Beginning work shall be considered acceptance of conditions.

B. Field verify dimensions affecting work of this Section prior to fabrication.

C. Ensure that openings have been properly sized, framed and prepared for installation of louvers and frames.

D. Ensure that flashings have been properly installed to divert moisture to the exterior of the building.

3.02 INSTALLATION

A. General: Install wall louvers and accessories in accordance with manufacturer’s written instructions and recommendations.

B. Install louvers in openings properly aligned and level.

C. Install louvers rigid and square with specified fasteners of non-corrosive metals.

D. Maintain required clearances and allow for expansion and contraction of materials.
E. Leave installation of metal wall louvers prepared to receive sealants, specified in Section 07900.

F. Coordinate installation of wall louvers with Division 15, Mechanical, for installation of fans, filters, ductwork and other mechanical equipment behind louvers.

END OF SECTION
SECTION 10440

INTERIOR SIGNAGE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish surface-mounted raised-letter acrylic signage as scheduled in Part 4 and on the Drawings.
B. Installation of same, unless arranged for otherwise.
C. Related work specified elsewhere:
   1. Section 01714, Construction Waste Management.
   2. Section 09260, Gypsum Wallboard.
   3. Section 09900, Painting.

1.02 QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. Manufacturer Qualifications: Interior signage system(s) shall be fabricated by a manufacturer with minimum five (5) years successful experience in projects of similar size and complexity.
C. Painted signage systems shall be applied by persons skilled in work of this type, with a minimum of five (5) years successful experience on projects of similar size and scope.
D. Signage systems shall comply with all applicable requirements of current ANSI 117.1 and the Americans with Disabilities Act, 1990, including signage size, lettering style, symbols, raised Braille and signage location, placement and mounting heights.
E. Manufacturer/Installer shall certify that interior signage components to be installed in exterior locations (i.e., handicapped accessible entry signage) are of materials and tamper-proof attachments consistent with the anticipated weather exposure.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and schedule of required signage, indicating type, size, style and method of installation.
   1. Schedule shall illustrate each required sign for size, style and copy, and indicate quantity required for each.
B. Samples: Submit samples of manufacturer's full line of standard colors and finishes for selection by the Architect. Submit one (1) full-size sample of representative signage system. Sample will be returned upon approval.

1.04 DELIVERY, STORAGE AND HANDLING

A. Package separately or in like groups of names, labeled as to the names enclosed. Include installation template, hardware or adhesives and installation instructions.

1.05 WARRANTIES

A. Provide manufacturer’s standard one-year warranty covering defects in materials and workmanship.
PART 2  PRODUCTS

2.01 ACRYLIC SIGNAGE SYSTEMS

A. Type: 2-ply acrylic signage with raised white lettering and symbols. All signage shall include raised Grade 2 Braille symbols.
   1. Fabricate white plastic room signs with edges mechanically and smoothly finished with square cut edges and 3/8” radiused corners. Sign face shall be edged with a recessed 1/8” border.
      a. Size: 6” high x 12” wide.
      b. Letters shall be black in color and in the Helvetica Medium letter style raised from the background not less than 0.03125 as required by ADAAG.
      c. Provide 1.125” letter height for room numbers, centered 2” from the top of the letter to the top of the sign. Center a 1/2” wide black Braille lettering panel 3/8” from the bottom of the sign.
      d. Provide raised copy and recessed Braille lettering in copy thickness not less than 0.03125” thick as required by ADAAG.

B. Copy: Reference the Drawings.

C. Symbols: All signage shall carry raised Braille symbols as required by the Americans with Disabilities Act, 1990.

D. Edges: Beveled.

E. Colors: White background with raised black lettering and symbols.

F. Approved Signage Fabricators:
   1. Gravo-Tac 2-ply system by New Hermes, Duluth, GA.

PART 3  EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall inspect the surfaces, substrates and conditions under which the signage is to be installed and notify the Contractor in writing of conditions which will prevent the successful installation of the signage.

B. Fabricator shall acquire digital graphics for the Owner’s logo or other signage graphics from the Owner prior to submittal of signage schedule and shop drawings.

3.02 INSTALLATION

A. General: Install signage after doors or walls are painted and finished, in locations scheduled on the Drawings or specified herein, using adhesives and/or tamperproof attachments as scheduled.

B. Install centered, level and in line, in accordance with the manufacturer’s instructions.

C. Install signage in locations and mounting heights as required by the Americans with Disabilities Act, 1990. Consult with the Architect as required for exact placement.
   1. Consult with Architect for mounting location for double doors.

D. Clean, polish and remove excess adhesive.

END OF SECTION
SECTION 10520

FIRE PROTECTION SPECIALTIES

PART 1  GENERAL

1.01  WORK INCLUDED

A. Furnish portable fire extinguishers, complete with surface-mounted wall brackets.
B. Furnish key access box for use by the local fire department, complete with mounting hardware.
C. Installation of same, unless arranged for otherwise.

1.02  QUALITY ASSURANCE

A. Reference Standards: Conform to the current requirements of applicable portions of standards, codes and specifications, except where more stringent requirements are shown or specified.
   1. NFPA Code: Comply with NFPA 10, "Portable Fire Extinguishers".
   2. UL Labels: Provide units that have been approved and listed by Underwriters Laboratories.
   3. Applicable provisions of the codes referenced in Section 01060, or as adopted by any jurisdiction with authority over this Project.
B. All accessories shall be furnished by one (1) manufacturer throughout the project.
C. Certification: Supplier shall certify that the fire extinguisher type specified for each space or building is appropriate for the type of materials and/or hazards anticipated to be encountered in each space, particularly specialized areas such as electrical equipment rooms.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's product data on all fire protection accessories and specialties for approval by the Architect.

1.04  WARRANTIES

A. Provide manufacturer's standard one-year warranty covering defects in materials and workmanship.

PART 2  PRODUCTS

2.01  PORTABLE FIRE EXTINGUISHERS

A. Type: Units shall be 10-lb. multi-purpose dry chemical pressurized type equipped with pressure gauge and which do not need recharging, except after use.
   2. Units shall be tested and approved by UL with a minimum 4A-60B:C rating. UL rating shall appear on extinguisher labels and be attached to, and a part of, fire extinguisher units.
   3. Instructions for repairs, maintenance and recharging shall be attached.
   4. Refer to certification requirements specified in paragraph 1.02 above.
B. Approved Manufacturer:
   2. Manufacturers providing materials of same design, function and performance are acceptable.

2.02  FIRE EXTINGUISHER WALL BRACKETS

A. Type: Manufacturer's standard mounting bracket, suited to fire extinguisher supplied, white baked enamel finish, complete with anchorage devices.
1. Supply each bracket with one (1) fire extinguisher specified above.

B. Approved Manufacturer:
1. J. L. Industries.
2. Manufacturers providing materials of same design, function and performance are acceptable.

2.03 KEY ACCESS BOX

A. Furnish surface-mounted heavy-duty key access box, complete with all mounting hardware, as required by Poudre Fire Authority, located as shown on the Drawings.
1. Series 3200 Knox-Box, manufactured by the Knox Company, Newport Beach, CA, (714) 650-2885, or equal approved by the agency with jurisdiction.

B. Quantity: One (1) per building.
C. Owner shall furnish a facility master key for use by the fire department.

PART 3 EXECUTION

3.01 INSPECTION AND PREPARATION

A. Installer shall examine the substrates and conditions under which the fire protection accessories are to be installed and notify the Contractor of conditions detrimental to the proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Contractor shall field verify dimensions and conditions governing the work of this Section. Ensure that openings for recessed or semi-recessed cabinets are properly sized and located.

C. Ensure that blocking in walls for semi-recessed and surface-mounted specialties is properly installed.

D. Verify servicing, charging and tagging of all fire extinguishers.

3.02 INSTALLATION

A. General: Install fire protection accessories where shown on the Drawings and in accordance with manufacturer’s written instructions and recommendations. Securely fasten all components in position, square and plumb, in accordance with recognized industry practices.

B. Install in locations as shown on the drawings or as required to comply with governing regulations.

C. Install fire extinguishers and/or cabinets at mounting height to comply with handicapped accessibility requirements:
1. Cabinet: 48’’ to centerline of handle.

D. Install key access box at mounting height to comply with requirements of the governing fire department:
1. Knox-Box: 6’-0” to centerline of access door, or as required by the Poudre Fire Authority.

PART 4 SCHEDULES

4.01 INSTALLATION SCHEDULE

A. General: Install fire extinguishers and cabinet at locations throughout the building so that the maximum travel distance from any point in the building to an extinguisher is 75’-0’’.

END OF SECTION
SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Description: Work shall consist of furnishing all labor, equipment, supplies, and materials, unless otherwise specified, necessary for the installation of complete electrical systems as required by the specifications and as shown on the drawings, subject to the terms and conditions of the contract. The Work shall also include the completion of those details of electrical work not mentioned or shown which are necessary for the successful operation of all electrical systems.
B. Certain labor, materials, and equipment may be furnished under other Sections of these specifications, by Utility Companies or by the Owner. When this is the case, the extent, source and description of these items will be as indicated on the drawings or as described in the specifications.

1.03 RELATED SECTIONS
A. Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 - General Requirements.
B. Refer to LEED Section 01352 for all LEED requirements.

1.04 REFERENCE STANDARDS
A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents. If there is a conflict between standards or between standards and the contract documents, the more stringent requirement shall apply. If there is a conflict between University of Colorado of Boulder Electrical Standards and contract documents, the more stringent requirement shall apply. The contractor is responsible for all costs of the more stringent requirement. A listing of applicable reference standards is contained in Division 1.
B. Latest editions of the following:
   3. NECA - Standard of Installation.
   4. The University of Colorado at Boulder Electrical Standards.
   5. Other references as listed elsewhere in these specifications.

1.05 DEFINITIONS
A. "Furnish" or "Provide": To supply, install and connect up complete and ready for safe and regular operation of particular work unless specifically otherwise noted.
B. "Install": To erect, mount and connect complete with related accessories.
C. "Supply": To purchase, procure, acquire and deliver complete with related accessories.
D. "Work": Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.
E. "Wiring": Raceway, fittings, wire, boxes and related items.
F. "Concealed": Embedded in masonry, concrete or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures.

G. "Exposed": Not installed underground or "concealed" as defined above.

H. "Indicated," "Shown" or "Noted": As indicated, shown or noted on drawings or specifications.

I. "Similar" or "Equal": Equal in materials, weight, size, design, construction, capacity, performance, and efficiency of specified product.

J. "Reviewed," "Satisfactory," "Accepted," or "Directed": As reviewed, satisfactory, accepted, or directed by or to Engineer.

K. "Related Work" includes, but is not necessarily limited to, mentioned work associated with, or affected by, the work specified.

L. Refer to Article 100 of the currently adopted National Electrical Code for other definitions as applicable to this project.

1.06 WORK SEQUENCE

A. Construct Work in sequence under provisions of Division 1 where applicable.

1.07 DRAWINGS AND SPECIFICATIONS

A. The drawings indicate the general arrangement of circuits and outlets, locations of switches, panelboards and other work. Information shown on the drawings is schematic, however, recircuiting will not be permitted without specific acceptance. Drawings and specifications are complementary each to the other. What is called for by one shall be as binding as if called for by both. Data presented on these drawings is as accurate as planning can determine, but accuracy is not guaranteed and field verification of all dimensions, locations, levels, etc., to suit field conditions is directed. Review all Architectural, Structural and Mechanical Drawings and Specifications; adjust all work to conform to all conditions shown therein. If there is a conflict between drawings and specifications or drawings between disciplines, contact the engineer of record and the architect immediately. The more stringent requirement shall apply.

B. Prior to submitting a bid, visit the site of the job and ascertain all conditions affecting the proposed installation and adjust all work accordingly. Make provisions for these costs.

C. Discrepancies between different plans, between plans and specifications, between specifications, or regulations and codes governing this installation shall be brought to the attention of the Engineer in writing before the date of bid opening. In the event such discrepancies exist, and the Engineer is not so notified, the adjudication of responsibility shall be solely at the discretion of the Engineer.

1.08 COORDINATION

A. Prior to fabrication or installation of any electrical work, participate in detailed coordination planning meetings with all other building utilities system trades, under the direction of the General Contractor, so as to completely establish routings, elevations, space requirements, and coordination of access, layout, and suspension requirements in relationship to the building structure and the work of all other trades.

1.09 SUBMITTALS (Refer to Division 1)

A. Submit shop drawings and product data in accordance with provisions of Division 1.

B. Prior to submission, shop drawings, material lists and catalog cuts or manufacturer's printed data shall be thoroughly checked for compliance with contract requirements, compatibility with equipment being furnished by the Contractor or Owner, accuracy of dimensions, coordination with work of other trades, and conformance with sound and safe practice as to erection of installation. Each submittal shall bear Contractor's signed statement evidencing such checking.

C. Clearly mark each shop drawing as follows for purposes of identification:

1. Shop Drawing
2. Equipment Identification Used on Contract Drawings
3. Date
4. Name of Project
5. Branch of Work
6. Engineer's Name
7. Contractor's Name

D. Clearly mark printed material, catalog cuts, pamphlets or specification sheets, and shop
drawings with the same designation shown on the contract document schedules. Identify
specific item proposed, showing catalog number, recess openings, dimensions, capacities,
electrical characteristics, etc. Submittals, which are incomplete, will be returned to the
Contractor without review.

E. Contractor agrees that submittals processed by the Engineer are not change orders; that the
purpose of submittals is to demonstrate to the Engineer that the Contractor understands the
design concept; and that the Contractor demonstrates this understanding by indicating which
equipment and material he intends to furnish and install and by detailing the fabrication and
installation methods he intends to use.

F. Contractor shall be responsible for dimensions (which he shall confirm and correlate at the
job site), fabrication processes and techniques of construction, and coordination of his work
with that of other trades. The Contractor shall check and verify all measurements and review
shop drawings before submitting them. If any deviations from the specified requirements for
any item of material or equipment exist, such deviation shall be expressly stated in writing
and incorporated with the submittal.

G. Maintain one copy of shop drawings at the project field office until completion of the project,
and make this copy available, upon request, to representatives of the Engineer and Owner.

H. No equipment or materials shall be installed or stored at the jobsite until submittals for such
equipment or materials have been given review action permitting their use.

I. Shop drawings and manufacturer's published data shall be submitted for:
   1. Luminaires (catalog cuts)
   2. All switchboards, panelboards
   3. Wiring Devices

1.10 RECORD DOCUMENTS

A. Maintain a contract set of electrical drawings at the site. Neatly mark all changes,
discoveries and deviations from the original drawings. Use a color which contrasts with the
prints. This shall be a separate set of drawings, not used for construction purposes, and shall
be kept up to date as the job progresses and shall be made available for inspection by the
Engineer at all times. Upon completion of the contract, this set of record drawings shall be
delivered to the Engineer. Record documents to be provided by the Contractor shall clearly
and accurately show the following:
   1. Major raceway systems, size and location, for both exterior and interior; locations of
      control devices; distribution and branch electrical circuitry; and fuse and circuit
      breaker size and arrangements.
   2. Equipment locations (exposed and concealed), dimensioned from prominent building
      lines.
   3. Approved substitutions, Contract Modifications, and actual equipment and materials
      installed.

1.11 REGULATORY REQUIREMENTS

A. Conform to those editions of the following as currently adopted by the local code
   enforcement authority:
   1. ANSI/NFPA 70.
   4. Comply with requirements of the utility and telephone companies furnishing service
to this installation.
   5. Other requirements as listed elsewhere in these specifications.
B. Obtain electrical permits, plan review, and inspections from authority having jurisdiction in accordance with Division 1.

C. The drawings and specifications take precedence when they are more stringent than codes, statutes, or ordinances in effect. Applicable codes, ordinances, standards and statutes take precedence when they are more stringent than, or conflict with the drawings and specifications.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and Equipment: Acceptable to the authority having jurisdiction as suitable for the use intended, except where more stringent requirements are indicated by the Contract Documents.

B. Compatibility with Available Space: Equipment layouts shown are based on use of equipment as specified. If the Contractor chooses equipment available from any other manufacturer listed as an acceptable manufacturer, or offers equipment under the provision for substitutions, the Contractor shall be solely responsible for first ascertaining that the offered equipment can be installed in the space available with ample clearances for maintenance. Include coordination drawings, as specified herein, when required.

C. All equipment and materials installed shall be new, unless otherwise specified.

D. Defective or damaged materials shall be replaced or repaired, prior to final acceptance, in a manner acceptable to the Engineer or Owner and at no additional cost to the Owner.

E. All electrical materials shall be acceptable for installation only if labeled or listed by a nationally recognized testing laboratory and if accepted by local authorities.

F. All major equipment components shall have the manufacturer's name, address, model number, and serial number permanently attached in a conspicuous location.

G. Adhesives and Sealants: For interior (i.e within the vapor barrier of the building) applications use adhesives and sealants that comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168 and for sealants and sealant primers, the Bay Area Air Quality Management District Regulation 8, Rule 51, summarized by the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24):
   1. Wood Glues: 30 g/L
   2. Metal to Metal Adhesives: 30 g/L
   3. Adhesives for Porous Materials (Except Wood): 50 g/L
   4. Subfloor Adhesives: 50 g/L
   5. Plastic Foam Adhesives: g/L.
   6. Rubber Floor Adhesives: 60 g/L.
   7. Ceramic Tile Adhesives: 65 g/L.
   8. Multipurpose construction Adhesives: 70 g/L.
   9. Fiberglass Adhesives: 80 g/L.
   10. Structural Glazing Adhesives: 100 g/L.
   11. Wood Flooring Adhesive: 100 g/L.
   12. Contact Adhesive: 80 g/L.
   13. Plastic Cement Welding Compounds: 250 g/L.
   14. ABS Welding Compounds: 325 g/L.
   15. CPVC Welding Compounds: 250 g/L.
   16. PVC Welding Compounds: 510 g/L.
   17. Adhesive Primer for Plastic: 550 g/L.
   18. Architectural Sealants: 250 g/L.
   19. Sealant Primers for Nonporous Substrates: 250 g/L.
   20. Sealant Primers for Porous Substrates: 775 g/L.
   21. Carpet Adhesives: 50 g/L.
   22. Carpet Pad Adhesives: 50 g/L.
   23. VCT and Asphalt Tile Adhesives: 50 g/L.
   24. Cove Base Adhesives: 50 g/L.
   25. Gypsum Board and Panel Adhesives: 50 g/L.

Williams Village irrigation Delivery and Storage System
100% Construction Documents
26. Special Purpose Contact Adhesive: 250 g/L.
27. Structural Wood Member Adhesive: 140 g/L.
28. Sheet Applied Rubber Lining Operations: 850 g/L.
29. Top & Trim Adhesive: 250 g/L.
30. Non Membrane Roof Sealant: 300 g/L.
31. Roadway Sealant 250 g/L.
32. Single Ply Roof Sealant: 450 g/L.
33. Other Sealants: 420 g/L.
34. General Aerosol Mist Adhesive: 65% VOCs by Weight
35. Special Purpose Aerosol Adhesives (All Types): 70% VOCs by Weight

H. Interior Paints and Coatings: For interior applications use paints and coatings that comply with Green Seal’s Standard GS-11, summarized by the following upper limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the following chemical restrictions:
1. Flat Paints and coatings: 50 g/L.
2. Non-Flat Paints and Coatings: 150 g/L.
3. Anti-Corrosive Coatings: 250 g/L.
4. Clear Wood finishes - Varnishes: 350 g/L.
5. Floor Coatings: 100 g/L.
6. Waterproofing Sealers: 250 g/L.
7. Sanding Sealants: 275 g/L.
8. All other Sealants: 200 g/L.
9. Stains: 250 g/L.
10. Paint Primer: 150 g/L.
11. Clear Shellacs: 730 g/L.
12. Pigmented Shellacs: 55 g/L.

2.02 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer’s instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer’s instructions.
B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
C. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.
B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not specifically named.
C. Products Specified by Naming One or More Manufacturers without a Provision for Substitutions: Products of named manufacturers meeting specifications; no options, no substitutions allowed.

2.04 PRODUCTS LIST

A. Within 30 days after date of Owner-Contractor Agreement, submit complete list of major products required for submittal under these specifications, with name of manufacturer, trade name, and model number of each product.

2.05 SUBSTITUTIONS

A. Refer to Division 1.
2.06 GUARANTEE

A. The entire electrical system installed under this Contract shall be left in proper working order. Replace, at no additional cost to the Owner, any work, materials, or equipment which evidences defects in design, construction, or workmanship within one year, or as specifically noted elsewhere in these specifications, from date of final acceptance.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. Install work using procedures defined in NECA Standard of Installation.
B. Workmanship shall conform to highest industry standards for each trade involved in erection of the work.
C. Contractor's personnel and subcontractors selected to perform the work shall be well versed and skilled in the trades involved.
D. Any changes or deviations from the drawings and specifications must be accepted in writing by the Engineer. All errors in installation shall be corrected at the expense of the Contractor. All specialties shall be installed as detailed on the drawings. Where details or specific installation requirements are not provided, manufacturer's recommendations shall be followed.
E. Upon completion of work, all equipment and materials shall be installed complete, thoroughly checked, correctly adjusted, and left ready for intended use or operation. All work shall be thoroughly cleaned and all residue shall be removed from surfaces. Exterior surfaces of all material and equipment shall be delivered in a perfect, unblemished condition.
F. Contractor shall provide a complete installation, including all required labor, material, cartage, insurance, permits, and taxes.

3.02 CHASES, OPENINGS, CUTTING AND PATCHING

A. Carefully lay out all work in advance so as to eliminate where possible, cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings and roofs. Any damage to the building, structure, piping, ducts, equipment or any defaced finish shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner and to the satisfaction of the Architect/Engineer. Any necessary cutting, channeling, drilling or welding as required for the proper support, concealment, installation or anchoring of raceways, outlets, or other electrical equipment shall be performed in a careful manner, and as approved by the Engineer.
B. All openings made in fire-rated walls, floors, or ceilings shall be patched and made tight in a manner to conform to the fire rating for the surface penetrated.
C. All penetrations required through completed concrete construction shall be core drilled at minimum size required. Precautions shall be taken when drilling to prevent damage to structural concrete. The Contractor shall obtain permission from the Engineer before proceeding with drilling.

3.03 ELECTRICAL INSTALLATIONS

A. Coordinate electrical systems, equipment, and materials installation with other building components. If equipment of a different size is furnished by the Contractor, the Contractor shall furnish and install the proper motor starter, fuses, circuit breaker, disconnect switch, wire and conduit required for the equipment furnished, at no additional cost to the Owner and shall be approved by the Owner.

3.04 PROGRESS OF WORK
A. Order the progress of electrical work to conform to the progress of the work of the other trades. Complete the entire installation as soon as the condition of the building will permit. Any cost resulting from defective or ill-timed work performed under this Section shall be borne by this Contractor.

3.05 TRENCHING AND BACKFILLING

A. Perform all trenching and backfilling required by work performed under this Section in accordance with the excavating and grading specifications and as herein specified.
B. Excavate trenches to the depth required for the utilities involved. The trench bottom shall be graded true and free from stones or soft spots, bottom of trenches must be compacted.
C. After installation of electrical work, backfill, tamp, and compact to insure against the possibility of differential settling, in conformity with Division 2 Specifications. Verify location of existing or new utilities and, if damaged by this Contractor, replace or repair.

3.06 ELECTRICAL COMPLETION

A. Operating and Maintenance Manuals and Parts Lists: Deliver three (3) complete operating & maintenance manuals and parts lists to the Owner at the time of the above required indoctrination. Fully explain the contents of the manuals as part of required indoctrination and instruct the Owner's personnel in the correct procedure in obtaining service, both during and after the guarantee period.
1. The operating and maintenance manuals and parts lists shall give complete information as to whom the Owner shall contact for service and parts. Include address and phone number. Furnish evidence that an authorized service organization regularly carries a complete stock of repair parts for these items (or systems), and that the organization is available for service. Service shall be furnished within 24 hours after requested.
B. Operating and Acceptance Tests: Provide all labor, instruments, and equipment for the performance of tests as specified below and elsewhere in these specifications. Submit three copies of a typewritten test report to the Engineer for his approval.
1. For a seven-day period after building has been placed into normal service, record the full load current in each phase or line at the main service entrance and submit to the Engineer.
2. Perform a careful inspection of the main switchboard bus structure and cable connections to verify that all connections are torqued to manufacturer's recommendations.
C. Clean-Up: Remove all materials, scrap, etc., relative to the electrical installation, and leave the premises and all equipment, lamps, fixtures, etc. in a clean, orderly condition. Any costs to the Owner for clean-up of the site will be charged against the Contractor.
D. Acceptance Demonstration: Upon completion of the work, at a time to be designated by the Engineer, the Contractor shall demonstrate for the Owner the operation of the entire installation, including all systems provided under this contract.
E. Final acceptance by the Owner will not occur until all operating instructions are received and Owner's personnel have been thoroughly indoctrinated in the maintenance and operation of all equipment.

3.07 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16111
CONDUIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Metal Conduit
B. Flexible Metal Conduit
C. Liquidtight Flexible Metal Conduit
D. Electrical Metallic Tubing
E. Nonmetallic Conduit
F. Fittings and Conduit Bodies

1.03 RELATED SECTIONS

A. Division 1 - Cutting and Patching.
B. Division 2 - Trenching: Excavation and backfill for conduit and utilities on site.
C. Section 16170 - Grounding and Bonding
D. Section 16190 - Supporting Devices and Seals
E. Section 16130 - Electrical Boxes and Fittings
F. Section 16195 - Electrical Identification

1.04 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) Externa lly Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
G. NEMA TC 2 - Electrical Plastic Conduit (EPC-40 and EPC-80).
H. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.05 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 16010.
B. Accurately record actual routing of conduits larger than two (2) inches or larger, regardless of location (i.e., above ceiling, below slab, etc.). Dimension from building columns.
C. Accurately record actual routing of all conduits installed in and under the slab. Dimension from the building columns.
1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products under provisions of Section 260500 and Division
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.

1.08 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 and to coordinate with the work of other trades.

PART 2 - PRODUCTS

2.01 CONDUIT REQUIREMENTS

A. Minimum Size, unless otherwise specified:
   1. Homeruns:
      a. 3/4-Inch above accessible ceilings.
      b. 3/4-Inch above unaccessible ceilings and in concrete slab.
      c. 1-Inch below grade and below slab on grade.
   2. Branch Circuits after the first junction point: 3/4-Inch conduit unless otherwise specified.
   3. Minimum size for any conduit is 3/4-Inch. Conduit smaller than 3/4-Inch is prohibited.

B. Underground Installations:
   1. More than 5-Feet from Foundation Wall: Use PVC Schedule 40 nonmetallic conduit, except as otherwise noted.
   2. Within 5-Feet from Foundation Wall: Use rigid steel plastic coated conduit.
   3. In or Under Slab on Grade: Use PVC Schedule 40 nonmetallic conduit.

C. Outdoor Locations, Above Grade: Use rigid steel conduit.

D. In Slab Above Grade:
   1. Use PVC Schedule 40 nonmetallic conduit, unless otherwise specified.
   2. Maximum Size Conduit in Slab: 3/4-Inch or as permitted by the Structural Engineer, based on field conditions.

E. Wet and Damp Locations: Use rigid steel conduit if subject to physical damage. Thickwall nonmetallic conduit in areas not subject to physical damage and acceptable to the local authority.

F. Dry Locations:
   2. Exposed: Use rigid steel conduit if subject to damage below 8-feet, otherwise use electrical metallic tubing.

G. MC and AC cable is prohibited.

2.02 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; material to match conduit.

2.03 PVC COATED METAL CONDUIT
A. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.04 FLEXIBLE METAL CONDUIT
A. Description: Interlocked steel construction.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
A. Description: Interlocked steel construction with PVC jacket.

2.06 ELECTRICAL METALLIC TUBING (EMT)
A. Description: ANSI C80.3; galvanized tubing.
B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, compression or set screw type.

2.07 NONMETALLIC CONDUIT
A. Description: NEMA TC 2; Schedule 40 PVC.
B. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Install conduit in accordance with NECA "Standard of Installation".
   1. Minimum size for any conduit is 3/4-Inch. Conduit smaller than 3/4-Inch is prohibited.
   2. Maximum length of flexible conduit and liquid tight flexible conduit is 3’ except for connections to lighting equipment which may be up to 6’ maximum length.
B. Rigid conduit shall be used in corrosive and/or hazardous location, and for surface mounted conduits on pads or floors of mechanical rooms.
C. Electrical metallic tubing shall be used in interior partitions and above ceiling. Electrical metallic tubing is prohibited in hazardous and/or corrosive locations, in concrete slabs or walls, and below grade.
D. Flexible metal conduit shall be used for final motor connections, transformer connections, mechanical equipment final connections, and lighting equipment final connections. MC and AC cable are prohibited.
E. Liquid tight flexible metal conduit shall be used for the final connections to motors and mechanical equipment in outdoor installations, damp or wet locations, and corrosive locations. Liquid tight flexible connections shall be used for the final three feet of connection to sprinkler and pre-action valves.
F. Nonmetallic conduit is allowed in concrete slabs and walls. Nonmetallic conduit is prohibited for interior use.
G. Install nonmetallic conduit in accordance with manufacturer's instructions.
H. Arrange supports to prevent misalignment during wiring installation.
I. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
J. Group related conduits; support using conduit rack. Construct rack using steel channel, provide space on each for 25 percent additional conduits.
K. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.
L. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

M. Do not attach conduit to ceiling support wires.

N. Arrange conduit to maintain headroom and present neat appearance.

O. Route exposed conduit parallel and perpendicular to walls.

P. Route conduit installed above accessible ceilings parallel and perpendicular to building elements and walls.

Q. Route conduit in and under slab from point-to-point. Dimension from building columns.

R. Do not cross conduits in slab except with written approval from the Structural Engineer.

S. Routing conduits parallel in the slab is prohibited except with written approval from the Structural Engineer.

T. Maintain adequate clearance between conduit and piping.

U. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

V. Cut conduit square using saw or pipe cutter; de-burr cut ends.

W. Bring conduit to shoulder of fittings; fasten securely.

X. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for twenty (20) minutes, minimum.

Y. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Z. Install no more than equivalent of four 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 size.

AA. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

BB. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.

CC. Incompatible materials: Do not use incompatible or dissimilar metal fittings on raceway systems. All fittings and conduits must be compatible.

DD. All surface mounted conduit shall be painted to match the surface mounted upon. Use paint appropriate for conduit application.

EE. Provide suitable pull string in each empty conduit except sleeves and nipples.

FF. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

GG. Ground and bond conduit under provisions of Section 16170.

HH. Identify conduit under provisions of Section 16112. Label all conduits: “Power 120/208,” “Lighting 120,” “Telecom,” “Control.”

II. Transition from underground nonmetallic conduit to above grade metal conduit or electrical metallic tubing shall be made in or below the slab. The transition between nonmetallic conduit and above grade conduit shall be made with a rigid steel, plastic coated elbow.

JJ. All exterior conduit elbows shall be rigid PVC coated.

KK. Underground Secondary Raceway from Primary Transformer

1. Nonmetallic conduit, located 36” below grade, with a plastic warning tape located at 18” below grade. Transition to PVC coated rigid metallic conduit 5’ from outside of building wall.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified.
3.03 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16123
BUILDING WIRE AND CABLE

PART 1 - GENERAL

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

1.02 SUMMARY
   A. Building Wire and Cable.
   B. Wiring Connections and Terminations

1.03 RELATED SECTIONS
   A. Section 16111 - Conduit
   B. Section 16130 - Electrical Boxes and Fittings.
   C. Section 16190 - Supporting Devices and Seals
   D. Section 16195 - Electrical Identification

1.04 REFERENCE STANDARDS
   A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents. A listing of applicable reference standards is contained in Division 1.
   B. NEMA WC 70 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
   C. NEMA WC 70 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.05 PROJECT CONDITIONS
   A. Verify that field measurements are as shown on Drawings.
   B. Conductor sizes are based on copper.
   C. Wire and cable routing shown on Drawings is appropriate unless dimensioned. Route wire and cable as required to meet project conditions.
   D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.06 COORDINATION
   A. Coordinate Work under provisions of Section 260500.
   B. Determine required separation between wiring and other work.
   C. Determine routing to avoid interference with other work.

PART 2 - PRODUCTS

2.01 BUILDING WIRE
   A. Thermoplastic-Insulated Building Wire: NEMA WC 70.
   B. Rubber-Insulated Building Wire: NEMA WC 70.
C. Feeders and Branch Circuits: Copper, 600 volt, insulation, THHN/THWN, or XHHW. Conductors #10 AWG and larger shall be stranded. Conductors smaller than #10 shall be solid.
D. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THWN, or XHHW.

2.02 REMOTE CONTROL AND SIGNAL CABLE
A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60 degree C, individual conductors twisted together, shielded, and covered with a PVC jacket.
B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a non-metallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.
D. Install all remote control and signal cables in cable tray, raceways, or supported every 4'-0" on bridal rings.

2.03 MODULAR WIRING SYSTEMS
A. Not allowed.

2.04 CABLE SYSTEMS
A. MC and AC cable is prohibited.

2.05 TERMINATION
A. Splices and taps are to carry full ampacity of conductors without perceptible temperature rise.

PART 3 - EXECUTION

3.01 GENERAL WIRING METHODS
A. Use no wire smaller than No. 12 AWG for power and lighting circuits, and no smaller than No. 14 AWG for control wiring.
B. Use No. 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet. For circuit amperes other than 20 ampere and for distances greater than listed above, calculate voltage drop and size conductors for a maximum of 3% voltage drop.
C. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
D. Provide full size neutral for each single phase circuit (multiwire circuits are prohibited by UCB).
E. Splice only in accessible junction or outlet boxes.
F. Neatly train and lace wiring inside boxes, equipment, and panelboards. Make temporary connections to panelboard devices with sufficient slack conductor to facilitate reconnections required for balancing loads between phases.
G. Damaged conductors during installation shall be replaced.
H. Install products in accordance with manufacturer's instructions.
I. Insulation types specified shall conform to NEC requirements for temperature, moisture and mechanical environment conditions.
3.02 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire-pulling lubricant for pulling No. 4 AWG and larger wires.
B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
C. Completely and thoroughly swab raceway system before installing conductors.
D. Length of conductors at receptacles, junction boxes and switches: At least 6” of free conductor shall be left at each outlet, junction box and switch for splices or connection of fixtures or devices.
E. Parallel conductor feeders shall be installed so that all runs are of identical equal length.

3.03 WIRING CONNECTION AND TERMINATIONS

A. Splice only in accessible junction boxes.
B. For No. 8 AWG and smaller, use insulated spring wire connectors with plastic caps.
C. Use split bolt connectors for copper wire splices and taps, No. 6 AWG and larger. Tape un-insulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
D. Thoroughly clean wires before installing lugs and connectors.
E. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
F. Terminate up to #10 AWG spare conductors with wire nuts. Use electrical tape for spare conductor #8 AWG and larger.
G. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
H. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
I. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.04 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.
B. Inspect wire and cable for physical damage and proper connection.
C. Torque test conductor connections and terminations to manufacturer’s recommended values.
D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

3.05 WIRE AND CABLE INSTALLATION SCHEDULE

A. Concealed Interior Locations: Building wire in raceways or cable as approved herein.
B. Exposed Interior Locations: Building wire in raceways.
C. Above Accessible Ceilings: Building wire in raceways or cable as approved herein.
D. Wet or Damp Interior Locations: Building wire in raceway.
E. Exterior Locations: Building wire in raceways.
F. Underground Locations: Building wire in raceways.
G. MC and AC cable is prohibited.

3.06 WIRE AND CABLE COLOR CODING

A. Wires No. 6 AWG and smaller shall be factory color-coded. Wire No. 4 AWG and larger shall be color-coded with color tape 6-inch length of exposed ends, and at every accessible junction box on the branch circuit or feeder.
120/208 Volts  277/480 Volts
A = Black    A = Brown
B = Red      B = Orange
C = Blue     C = Yellow
Neutral = White Neutral = Grey
Ground = Green Ground = Green

B. Maintain the color-coding throughout the system from panel to the last device on the branch circuit.

3.07 FIELD QUALITY CONTROL

A. Prior to energizing, all feeders from transformers, switchboards, and building service cables, are to be tested with a 500-volt insulation megohm meter to determine insulation resistance levels to assure requirements are fulfilled. All field test data is to be recorded and submitted. Test is to include meggering for one minute between conductors and between each conductor and ground. Cables are to be meggered after installation with cables disconnected at both ends. The values must be not less than as follows:

<table>
<thead>
<tr>
<th>Conductor Size</th>
<th>Resistance (Megohms 1000 ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#16 AWG to #8 AWG</td>
<td>200</td>
</tr>
<tr>
<td>#6 AWG to #2/0 AWG</td>
<td>100</td>
</tr>
<tr>
<td>#3/0 AWG to 500 KCMIL</td>
<td>50</td>
</tr>
</tbody>
</table>

3.08 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16130
ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Wall and Ceiling Outlet Boxes
B. Floor Boxes
C. Pull and Junction Boxes

1.03 RELATED DOCUMENTS

A. Drawings, general and special conditions, Division 1 - General Requirements and other applicable technical specifications apply to work of this Section.

1.04 RELATED SECTIONS

A. Division 7 - Firestopping.
B. Division 8 - Access Doors: Wall and ceiling access doors.
C. Section 16160 - Cabinets and Enclosures.

1.05 REFERENCE STANDARDS

A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents. A listing of applicable reference standards is contained in Division 1.
B. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
C. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.06 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.
B. Verify locations of floor boxes and outlets prior to rough-in.
C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. Include installation within 10-feet of location shown. Refer to Architectural Drawings.

PART 2 - PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, with 2-inch male fixture studs where required.
B. Cast Boxes: NEMA FB 1, Type FD, cast ferroalloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
2.02 FLOOR BOXES

A. Floor Boxes: ANSI/NEMA OS 1 or NEMA FB 1, fully adjustable, cast iron or formed galvanized steel.

2.03 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1; galvanized steel.
B. Sheet Metal Boxes Larger than 12-Inches in Any Dimension: Hinged enclosure in accordance with Section 260535.
C. Surface-Mounted Cast Metal Box: NEMA 250, Type 6; flat-flanged, surface-mounted junction box.
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
E. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.
F. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
G. Use flush mounting outlet boxes in finished areas.
H. Do not install flush mounting boxes back-to-back in walls; provide minimum 6-inch separation. Provide minimum 12-inch separation between back-to-back boxes in acoustic-rated walls.
I. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
J. Use stamped steel bridges to fasten flush mounting outlet box between studs.
K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
L. Use adjustable steel channel fasteners for hung ceiling outlet box.
M. Do not fasten boxes to ceiling support wires.
N. Support boxes independently of conduit, except cast box that is connected to two (2) rigid metal conduits both supported within 12 inches of box.
O. Use gang box where more than one (1) device is mounted together. Do not use sectional box.
P. Use gang box with plaster ring for single device outlets.
Q. Use cast outlet box in exterior locations exposed to the weather and wet locations.
R. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
S. Set floor boxes level.
T. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12-inches in any dimension.
   1. Interior Dry Locations: Use hinged enclosure under provisions of Section 260535.
   2. Other Locations: Use surface-mounted cast iron box.
U. Minimum junction and pull box size 4-11/16” x 4-11/16” x 2-1/4”.
V. Minimum outlet box size 4” x 4” x 2”.
W. Minimum telephone outlet box size 4-11/16” x 4-11/16” x 2-1/4”.
X. Minimum junction box size for fire alarm pull stations, control module, monitor module, 4” x 4” x 2-3/4”. Provide plaster ring at all pull station locations.
Y. Box extensions are prohibited.
3.02 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of outlet box for products furnished under other sections.
B. Coordinate locations and sizes of required access doors with Division 8.
C. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
D. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
E. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.03 ADJUSTING

A. Adjust floor box flush with finish flooring material.
B. Adjust flush-mounting outlets to make front flush with finished wall material.
C. Install knockout closure in unused box openings.

3.04 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16160
Cabinets and Enclosures

Part 1 - General

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

1.02 Section Includes
   A. Hinged cover enclosures.
   B. Cabinets.
   C. Terminal blocks.
   D. Accessories.

1.03 Related Sections
   A. Section 16190 - Supporting Devices and Seals.

1.04 References
   A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.

1.05 Submittals
   A. Submit under provisions of Section 16010.
   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 products.

1.06 Extra Materials
   A. Provide two of each cabinet key.

Part 2 - Products

2.01 Hinged Cover Enclosures
   A. Construction: NEMA rated enclosure, steel, suitable for environment in which installed.
   B. Covers: Continuous hinge, held closed by flush latch operable by key. (National #C413A).
   C. Appropriate (minimum 14 gauge) gauge steel enclosure suitable for mounting electrical components, terminal boxes, etc.
   D. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with matte white enamel.
   E. Cabinets over 12: in any direction shall have ¼” turn latches.
   F. Enclosure Finish: Manufacturer's standard enamel.

2.02 Cabinets
A. Boxes: Galvanized steel with removable endwalls.
B. Box Size: As indicated.
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.

2.03 TERMINAL BLOCKS

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
D. Provide ground bus terminal block, with each connector bonded to enclosure.

2.04 FABRICATION

A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
B. Provide conduit hubs on enclosures.
C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive Work.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer’s instructions.
B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
C. Install cabinet fronts plumb.
D. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
E. Provide recessed boxes in all finished areas.

3.03 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Power System Grounding
B. Communication System Grounding
C. Electrical Equipment and Raceway Grounding and Bonding

1.03 REFERENCE STANDARDS

A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents.
B. NFPA Compliance: NFPA 70 "National Electrical Code (NEC)."
C. UL Compliance: Applicable requirements of UL Standards Nos. 467 "Electrical Grounding and Bonding Equipment," and 869, "Electrical Service Equipment," pertaining to grounding and bonding of systems, circuits and equipment. In addition, require compliance with UL Std 486A, "Wire Connectors". Grounding and bonding products which are to be UL-listed and labeled for their intended usage.
D. IEEE Compliance: Applicable requirements and recommended installation practices of IEEE Standards 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

1.04 SYSTEM DESCRIPTION

A. Ground the electrical service system neutral at service entrance equipment to metallic cold water service, building steel and to supplementary grounding electrodes, as indicated on drawings.
B. Ground each separately-derived system neutral to nearest metallic cold water pipe 2-inch diameter or larger, building steel and where present to the referenced ground bar as shown on drawings.
C. Provide communications system grounding conductor at point of service entrance and connect to nearest referenced ground bar as shown on drawings.
D. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ground Rods: Copper or copper-clad steel, 3/4-inch diameter, minimum length 10 feet.
B. Mechanical Grounding Connectors: For all grounding connections above grade.
   1. Manufacturer: Burndy Electrical
   2. Material: Copper.
   3. Compression Type: Irreversible.
4. UL listed under Standard UL467.

C. Wire:
   1. Material: Copper.
   2. Size: As indicated on the drawings. When size is not indicated, size per Article 250 of NEC requirements.

D. Grounding Connection Accessories:
   1. Electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type service required.

E. Field Welding: Exothermic welded connections are required where grounding conductors connect to underground grounding conductors and to underground grounding electrodes, and for bonding to steel. All underground connection shall be exothermic welded.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide a separate, insulated equipment grounding conductor in feeder and branch circuits. Terminate each ground conductor to the bushing and ground lug.

B. Connect grounding electrode conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange.

C. Supplementary Grounding Electrode: Use grounding mats, or driven ground rods, where indicated. Install ground rods in suitable recessed well; fill with gravel after connection is made.

D. Use minimum No. 6 AWG copper conductor for communications service grounding conductor. Leave 10-feet slack conductor at terminal board or cabinet.

E. Provide isolated grounds for all microprocessor and data processing equipment, where indicated on drawings.

F. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, connections are to be tightened to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

G. Provide code-sized ground cable bonding jumpers, installed with ground clamps, across all conduit expansion couplings and fittings.

H. Route grounding connections, conductors to ground, and grounding conductors to protective devices in the shortest and straightest paths possible to minimize transient voltage rises.

I. Provide a corrosion-resistant finish to field connections, buried metallic bonding products, and where factory applied protective coatings have been destroyed, where subject to corrosive action.

J. All continuous runs of cable tray and all isolated sections of cable tray shall be grounded at intervals not to exceed 20 feet.

K. Provide an equipment grounding conductor in all non-metallic conduits.

L. Provide an equipment grounding conductor in all flexible metallic conduits.

M. Grounding conductor in feeders and branch circuits extend ground conductor to switches, receptacle, equipment enclosures, equipment, and panels etc. and ground as required.

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, the ground resistance shall be tested with an earth ground resistance tester in accordance with IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Where tests show resistance-to-ground is over values in Table 1 below, Contractor shall take appropriate action to reduce resistance.
to the values in Table 1, by driving additional ground rods; and then retest to demonstrate compliance. All results shall be recorded and submitted.

Table 1

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Equipment (Ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad Mount Transformer</td>
<td>5</td>
</tr>
<tr>
<td>Secondary Neutrals and Other Ground</td>
<td>10</td>
</tr>
</tbody>
</table>

3.03 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16190
SUPPORTING DEVICES AND SEALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Conduit and equipment supports.
B. Fastening hardware.
C. Wall and floor seals.

1.03 RELATED DOCUMENTS

A. Drawings, general and special conditions, Division 1 - General Requirements and other applicable technical specifications apply to work of this Section.

1.04 RELATED SECTIONS

A. Division 3 - Cast-in-Place Concrete. Concrete equipment pads.
B. Coordinate size, shape and location of concrete pads with Division 3.
C. Refer to Section 16010 for coordination requirements.

1.05 REFERENCE STANDARDS

A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents. A listing of applicable reference standards is contained in Division 1.

1.06 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Support Channel: Galvanized or painted steel for non-corrosive environment.
B. Hardware: Corrosion-resistant.

PART 3 - EXECUTION

3.01 INSTALLATION
A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, or beam clamps. Do not use spring steel clips and clamps; however, caddy fasteners are accepted.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

D. Do not drill structural steel members.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. Install all free-standing electrical equipment on a 4-inch concrete housekeeping pad.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

I. Where conduit penetrates fire-rated walls, concrete and/or masonry walls and floors, it shall be sleeved. Seal opening around conduit with UL listed foamed silicone elastomer compound.

J. Where conduit penetrates waterproofed floors or exterior walls subject to entry of moisture, provide pipe sleeves two sizes larger than conduit, suitably flashed or sealed where appropriate. Seal annular space around conduit with UL listed foamed silicone elastomer compound.

K. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.

L. No suspended conduit or box supports shall be less than 1/4-inch diameter steel rod. Rod used as pedestal support is not acceptable. The contractor shall not use tie wire or wire of any type to support conduits, junction boxes or pull boxes.

M. No more than five (5) 1/2-inch conduits, three (3) 3/4-inch conduits or two (2) 1-inch conduits shall be supported on a single 1/4-inch diameter steel rod.

N. All conduits shall be supported by approved hangers. Supports installed and used by other trades such as duct hangers, pipe hangers, ceiling hangers, etc. shall not be used for conduit support. No conduit shall be hung from air handling duct of any type. Electrical conduit systems "shall stand alone".

O. All luminaires shall be independently supported at opposite corners from structural steel or from trapeze supported from structural steel by electrical contractor.

P. Wall-mounted luminaires shall be supported from building structure with approved backing support to prevent any damage to the wall.

Q. Concrete anchors shall not be used to suspend heavy electrical loads such as electrical switch panels or four-inch and larger conduits. Anchors shall be designed to support conduits and cable tray when full fitted to maximum capacity with cables.

3.02 EQUIPMENT BASES

A. Provide equipment pad bases of concrete type, construction, and finish as herein specified. Bases shall be of dimensions indicated or, where not specifically indicated or specified, dimensions shall be 4 inches height with width and length providing 4 inches of projection of base beyond outline dimension of supported equipment.

1. Concrete shall be Class 3000, prepared in conformity with ACI 301, ASTM C 33, and ASTM C 94, as applicable. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping, using equipment and procedures for consolidation of concrete in accordance with ACI 309. Perform consolidation so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Perform curing of concrete by moist curing, by moisture-retaining cover curing, or by combinations thereof, as directed or approved.

2. Provide oiled wood forms for concrete placement, adequately braced to ensure straight and vertical sides for bases. Finished bases shall provide a 3/4-inch chamfer at all exposed edges. Except where vibration attenuating base mountings are specified, provide No. 4 dowels (conforming to ASTM A 615, Grade 60), grouted into
place, for anchorage of bases to substrate for all applications for which imposed strains or dynamic forces produced by equipment operation introduce the possibility of displacement of bases. Spacing of dowels shall be not less than 24 inches o.c., with a minimum of 4 dowels for each base.

3. Bases where indicated shall be reinforced by installation of 6 x 6 No. 8 AWG welded wire fabric conforming to ASTM A 185. Apply measures, during concrete placement, to ensure that fabric remains vertically centered in bases.

4. Bring slab surfaces to correct level with straightedge and strikeoff. Do not disturb slab surfaces prior to beginning finishing operations. Float finish surfaces and provide steel trowel final finish.

B. For all equipment to be installed on concrete bases or other concrete construction, provide templates, anchor bolts, and accessories as required. When installing equipment, set equipment into final position, shim equipment bases, skids or rails for level positioning, and install non-shrink grout for uniform support, and securely bolt into final position.

3.03 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

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

1.02 SUMMARY
   A. Buried and Duct Bank Warnings.
   B. Electrical Power, Control and Communication Conductors and Conduit.
   C. Operational Instructions and Warnings.
   D. Danger Signs.
   E. Equipment/System Identification Signs.

1.03 RELATED SECTIONS
   A. Division 9 - Painting.

1.04 REFERENCE STANDARDS
   A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents. A listing of applicable reference standards is contained in Division 1.

1.05 QUALITY ASSURANCE
   A. ANSI Compliance: Applicable requirements of ANSI A13.1, “Piping and Piping Systems”.
   B. FS Compliance: Applicable requirements of FS L-P-387 “Plastic Sheet, Laminated, Thermosetting (for designation plates)”.
   D. NEMA Compliance: Applicable requirements of NEMA Standard Nos. WC-1 and WC-2 pertaining to identification of power and control conductors.
   E. Comply with “OSHA” sign standards for danger, caution, warning, etc.

PART 2 - PRODUCTS

2.01 ELECTRICAL IDENTIFICATION MATERIALS
   A. General: The manufacturer's standard products of categories and types required are to be used for each application.
   B. Color-Coded Emergency Power Conduit Markers:
      1. Manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick. Tape 1-1/8-inch wide by 4-1/2-inch long marker for 2-inch and smaller conduit. Tape 2-1/4-inch wide by 9-inch long marker for 2-1/2-inch and larger conduit. Black lettering is to indicate highest voltage of cable(s) in conduit.
2. Colors: Red tape.

C. Underground Type Plastic Line Marker:
   1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6-inches wide x 4 mils thick. Printing is required on tape, which most accurately indicates type of service.
   2. Color: Yellow.

D. Cable/Conductor Identification Bands:
   1. For cables smaller than No. 2/0 manufacturer’s standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap are to be used and numbered to show circuit identification.
   2. For cables No. 2/0 AWG and larger, heat shrink sleeving is to be used for phase color coding.

E. Plasticized Tags:
   1. Manufacturer’s standard preprinted or partially preprinted accident-prevention and operational tags, on plasticized card stock with matte finish suitable for writing, approximately 3-1/4-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate preprinted wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.

F. Baked Enamel Danger Signs:
   1. Manufacturer’s standard “DANGER” signs of baked enamel finish on 20-gauge steel; of standard Red, Black and White graphics; 14-inch x 10-inch size except where 10-inch x 7-inch is the largest size which can be applied where needed; with recognized standard explanation wording, e.g., XXXX VOLTS, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH, etc.

G. Engraved Plastic-Laminate Signs:
   1. Engraved stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of sizes and wording indicated, White face and Black core (Black letters on a White background) except as otherwise required (emergency power and fire alarm shall be Red with White letters), punched for mechanical fastening with a minimum of two (2) screws.
   2. Thickness: 1/16-Inch, for units up to 20 square inches or 8-inch length; 1/8-inch for larger units.
   3. Fasteners: A minimum of two (2) self-tapping stainless steel screws.
   4. Minimum letter height shall be as follows:
      a. 1/2-Inch:
         1) Panelboard name.
         2) Switchboard name.
         3) Transformer name.
         4) Transformer switch name.
         5) System control panel name.
      b. 1/4-Inch:
         1) Voltage rating.
         2) Ampere rating.
         3) Source circuit (“Fed from Normal or Generator”).
         4) Individual circuit breaker number and load name.
         5) Individual switch circuit number and load name.
         6) Individual motor starter circuit number and load name.
         7) Individual indicating light function.
         8) Individual pushbutton function.
         9) Individual selector switch functions.

H. Lettering and Graphics:
   1. Names, abbreviations and other designations used in electric identification work are to be coordinated with corresponding designation shown, specified or scheduled.
Numbers, lettering and wording as required or as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.

I. Adhesive Marking Tape for Device Cover Plates:
   1. Avery-type or equal with 3/16-inch minimum height letters. Labels shall have black letters on clear labels for normal and red letters on clear labels for emergency. Embossed Dymo-Tape labels are not acceptable.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:
   1. Regulations: Governing regulations and requests of governing authorities are to be complied with for identification of electrical work.

B. Underground Conduit and Ductbank Identification:
   1. During back-filling/top-soiling of each exterior underground conduit and ductbank, a continuous underground-type plastic line marker, located directly over conduit or ductbank at 12-inches below finished grade or 4-inches below paving, shall be provided.

C. Cable/Conductor Identification:
   1. Provide wire markers on each conductor at points of termination in panelboards, outlet and junction boxes, and at load connections. Identify with branch circuit or feeder number for power and lighting circuits and with control circuit number for control wiring. Install wire markers in panelboard between deadfront and edge of can.

D. Junction Box and Pull Box Identification:
   1. On the cover of each junction box and pull box: The circuit number(s) of the enclosed conductors are to be legibly written with a Black permanent ink broad tip marking pen and the system identified for FA (Fire Alarm) EM (Emergency) PA (Public Address), S (Security) TC (Temperature Control).
   2. Covers for Emergency System junction boxes and pull boxes shall be painted Yellow.
   3. Covers for the Fire Alarm System junction boxes and pull boxes shall be painted Red.
   4. Covers for the Telephone System junction boxes and pull boxes shall be painted Green.
   5. Covers for the Television System junction boxes and pull boxes shall be painted Violet.
   6. Covers for the Computer/Data System junction boxes and pull boxes shall be painted Blue.

E. Conduits
   1. Install identification label on concealed inaccessible conduits within three feet of becoming inaccessible. Label all conduits: “Power 120/208,” “Lighting 120,” “Telecom,” “Control.”

F. Operational Identification and Warnings:
   1. Wherever required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures shall be provided. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

G. Caution Signs:
1. The following caution sign is to be provided for all circuit breakers and switchboards where turning off a circuit will automatically start an emergency operation:

"CAUTION TURNING OFF THIS CIRCUIT WILL AUTOMATICALLY START EMERGENCY OPERATION."

2. The following caution sign is to be provided for all automatic transfer switches, switches, circuit breakers, equipment, and emergency panels that are energized by the emergency power system:

"CAUTION AUTOMATICALLY ENERGIZED BY EMERGENCY POWER SUPPLY SYSTEM."

H. Equipment/System Identification:

1. An engraved plastic-laminated sign is to be provided on each major unit of electrical equipment in the building; including central or master unit of each electrical system including communication/control/signal/alarm systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, letter height as specified, black lettering on white field. Provide text matching terminology and numbering of the contract documents and shop drawings. The sign shall include unit designation, source circuit number, circuit voltage, and other data specifically indicated. Also, the sign shall indicate normal source circuit number ("Fed from . . .") and emergency source circuit number when the equipment is a transfer switch or fed directly from a transfer switch. Include signs for each unit of the following categories of electrical work:
   a. Switchboards, panelboards (include main bus ampacity on sign), electrical cabinets and enclosures.
   b. Access panel/doors to electrical facilities.
   c. Disconnect switch.
   d. Push buttons, selector switches, indicating lights. (Circuit number and voltage not required on sign).
   e. Power transfer equipment: Contactors and transfer switches.
   f. Power generating units.
   g. Telephone cabinets and switching equipment. (Circuit number and voltage not required on sign.)
   h. Fire Alarm Control Panel.

2. The installation of signs are required at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. The sign shall be secured to the substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

I. For panelboards, provide framed, typed circuit schedules (label all spares and spaces in pencil) with explicit description and identification of items controlled by each individual breaker.

J. Provide tape labels for identification of individual receptacles and switches. Locate tape on back of plate and indicate associated source panelboard and circuit number.

3.02 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16441

ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Fusible Switches
B. Non-fusible Switches

1.03 RELATED SECTIONS

A. Section 16477- Fuses.

1.04 REFERENCES

A. NECA - Standard of Installation (published by the National Electrical Contractors Association).
B. NEMA FU1 - Low Voltage Cartridge Fuses.
C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
E. NFPA 70 - National Electrical Code.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.06 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

2.01 MANUFACTURERS

A. Acceptable Manufacturers
   1. Eaton Corporation
   2. General Electric
   3. Square-D
   4. Siemens

2.02 FUSIBLE SWITCH ASSEMBLIES

A. Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
B. Fuse Clips: Designed to accommodate NEMA FU1, Class R fuses.
2.03 NONFUSIBLE SWITCH ASSEMBLIES

A. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.

2.04 ENCLOSURES

A. Fabrication: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.
   3. Exterior Locations (Submersible): Type 4X.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with NECA "Standard of Installation".
B. Install fuses in fusible disconnect switches.
C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 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 7.5.

3.03 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. RFI: Radio-frequency interference.
D. RMS: Root mean square.
E. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
B. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.
C. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
D. Panelboard Schedules: For installation in panelboards.
E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements.”
C. 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.
D. Comply with NEMA PB 1.
E. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Altitude not exceeding 6600 feet (2000 m).

1.07 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.
B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.08 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. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
      a. Eaton Corporation
      c. Siemens Energy & Automation, Inc.
      d. Square D

2.02 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals. Series rating is not allowed.
2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response. (Not Applicable)
   5. GFP Circuit Breakers: Single configuration with 5mA Trip.
   6. AFCI Circuit Breakers: Use in Apartment Panelboards.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.
B. Mount top of trim 78 inches above finished floor, unless otherwise indicated.
C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
D. Install overcurrent protective devices and controllers.
   1. Set field-adjustable switches and circuit-breaker trip ranges.
E. All panelboards shall be full of breakers.
F. For every three spare breakers, stub one ¾” empty conduit out of flush mounted panelboards into accessible area.
G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section “Identification for Electrical Systems.”
B. Create a directory to indicate installed circuit loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
B. Connect wiring according to Division 26 Section "Building Wire and Cable."

3.04 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.
B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
   1. Measure as directed during period of normal system loading.
   2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
   3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
   4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.05 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.06 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
OUTER DOOR TO SWING FROM HINGE TO OUTER EDGE OF CAN.
SURFACE MOUNT — COVER SAME SIZE AS CAN.
FLUSH MOUNT — COVER TO BE LARGER (OVERLAP ALL EDGES) THAN CAN TO
CONCEAL EDGE OF CAN.
SECTION 16477
FUSES

PART 1 - GENERAL

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

1.02 SECTION INCLUDES
   A. Fuses.

1.03 REFERENCES
   B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.04 SUBMITTALS
   A. Submit under provisions of Section 16010.
   B. Product Data: Provide data sheets showing electrical characteristics including time-current
      curves.

1.05 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Section 260500.
   B. Record actual fuse sizes.

1.06 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing the products specified in this section
      with minimum three years experience.

1.07 REGULATORY REQUIREMENTS
   A. Conform to requirements of NFPA 70.
   B. Furnish products listed and classified by UL and referenced standards as suitable for purpose
      specified and indicated.

1.08 MAINTENANCE MATERIALS
   A. Provide two fuse pullers.

1.09 EXTRA MATERIALS
   A. Provide three of each size and type fuse installed.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Bussman
   2. Littelfuse
   3. Ferraz-Shawmut

2.02 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.

PART 3 - EXECUTION

3.01 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.

3.02 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Interior lighting luminaire, lamps, and ballasts.
   2. Lighting luminaire supports.

1.03 DEFINITIONS

A. BF: Ballast factor.
B. CRI: Color-rendering index.
C. CU: Coefficient of utilization.
D. HID: High-intensity discharge.
E. LER: Luminaire efficacy rating.
F. Luminaire: Complete lighting fixture, including ballast housing if provided.
G. RCR: Room cavity ratio.

1.04 SUBMITTALS

A. Product Data: For each type of luminaire, arranged in order of designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Emergency lighting units including battery and charger.
B. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

1.06 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In Interior Lighting Luminaire Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 LUMINAIRE AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
B. Fluorescent Fixtures: Comply with UL 1598.
C. Metal Parts: Free of burrs and sharp corners and edges.
D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
E. 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.
F. 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.
   4. Laminated Silver Metallized Film: 90 percent.
G. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

2.03 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; programmed-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
   1. Sound Rating: A.
   2. Total Harmonic Distortion Rating: Less than 10 percent.
   3. Transient Voltage Protection: IEEE C62.41, Category A or better.
   4. Operating Frequency: 42 kHz or higher.
   5. Lamp Current Crest Factor: 1.7 or less.
   6. BF: 0.85 or higher.
   7. Power Factor: 0.98 or higher.
   8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
B. Ballasts for Low-Temperature Environments:
   1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

2.04 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with 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.

B. Super T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 3150 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K, and average rated life 24,000 hours, unless otherwise indicated.

C. Super T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 82 (minimum), color temperature 3500 K, and average rated life of 24,000 hours, unless otherwise indicated.

2.05 LUMINAIRE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.06 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Reference luminaire schedule on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Luminaires: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Luminaires in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

4. Install at least one independent support rod or wire from structure to a tab on lighting luminaires. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
C. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.
E. Connect wiring according to Division 16 Section “Building Wire and Cable.”

3.02 CONSTRUCTION WASTE MANAGEMENT

A. Construction Waste Management: Construction Waste shall be managed in accordance with provisions of Section 01 74 19 Construction Waste Management. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION
SECTION 32 82 00

VERTICAL TURBINE IRRIGATION AND TRANSFER PUMP SYSTEMS

PART 1 GENERAL

1.1 SCOPE

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete manufacturing of the irrigation pump system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

A. Procurement of all applicable licenses, permits, and fees as required by local utilities and regulations.

B. Coordination of Utility Locates (“Call Before You Dig”)

C. Services of a factory field service person to supervise the assembly, installation, and start-up of the irrigation pump system, and the training of maintenance staff, and provision of O&M manual.

D. Installing a prefabricated, vertical turbine type pumping system including pumps, motors, electrical controls, and other items as specified. Irrigation pump system to be procured by University of Colorado at Boulder.

E. Furnishing and installation of submersible transfer pumps and pump guide rail system.

F. Furnishing and installation of water level sensor probes and controls for the transfer pump wet well.

G. Connection of electrical power supply to the vertical turbine pump station and transfer pumps. Refer to electrical plans for sizing and routing of conduit and conductors.

H. Connection of transfer pump station controls and level sensors back to main vertical turbine pump station control panel located within the irrigation pump station building. Refer to electrical plans for sizing and routing of conduit and conductors.

I. Maintenance period.

1.2 RELATED SECTIONS

A. 32 82 13 – Pump Station Intake System

B. 32 82 23 – Lake Aeration System
C. 32 84 00 – Landscape Irrigation System

1.3 DISCREPANCIES

It is the intent of these plans and specification that the irrigation pump system be complete and workable. It is the CONTRACTOR's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Owner's Representative for clarification.

1.4 WORK NOT INCLUDED

A. Provision and installation of electrical transformer on site.

1.5 SUBMITTALS

A. Deliver four (4) copies of submittals to Owner's Representative within 10 working days from date of Notice to Proceed. Furnish information in 3-ring binder with table of contents and index sheet. Index sections for different components and label with specification section number and name of component. Furnish submittals for components on material list. Indicate which items are being supplied on catalog cut sheets when multiple items are shown on one sheet. Incomplete submittals will be returned without review.

B. Materials List: Include pipe, valve, fittings, transfer pumps and motors, and electrical equipment. Quantities of materials need not be included.

C. Manufacturers' Data: Submit manufacturers' catalog cuts, performance curves, specifications, and operating instructions for equipment shown on the materials list. Submit complete instructions for installation, operation, and recommended maintenance of the pump system.

D. Maintenance Manual: Submit four copies of a bound maintenance manual that includes all manufacturers’ data listed above and recommended operating procedures and preventive maintenance procedures. Include guide for troubleshooting operational problems with the irrigation pump system and transfer pump and complete documentation for programming, recommended settings and adjustments.

E. Shop Drawings: Submit shop drawings of proposed transfer pump system. Show products required for proper installation, their relative locations, and critical dimensions. Submit technical data sheets, electrical schematics, sequence of operation, UL listing authorization form. Note modifications to the installation drawings.

F. Record drawings as required in the specifications.
1.6 RULES AND REGULATIONS

A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.

B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.

C. All electrical control panels with controls shall be built in accordance to N.E.C., U.L. and E.T.L. standards. The electrical components and enclosure shall be labeled as a complete U.L. listed assembly with manufacturer’s U.L. label applied to the door. All equipment and wiring shall be mounted within the enclosure and labeled for proper identification.

D. Provide single source responsibility for the warranty, service, operation, and installation of a prefabricated, skid mounted, fully automatic variable speed irrigation pump system and transfer pump as described in contract documents. The pumping system must conform to the following specifications in all respects. This specification covers the minimum requirements; however, it should not be construed as all inclusive.

1.7 TESTING

A. Notify the Owner’s Representative three days (72 hours) in advance of testing.

B. Bump manual motor starter controls to prove correct rotation and secure local inspection/approval.

C. Test, verify, and demonstrate to the Owner’s Representative the proper operation of all control and safety shut off devices.

D. Verify flow and discharge pressure from the irrigation pump system and transfer pumps and demonstrate to the Owner’s Representative system performance based on the specified values.

E. All costs, including travel expenses and site visits by the Owner or regulatory authority, for any additional reviews that may be required due to non-compliance with the Construction Documents shall be the sole responsibility of the CONTRACTOR.
1.8 REVIEWS

The purpose of on-site reviews by the Owner’s Representative is to observe the CONTRACTOR's interpretation of the construction documents and to address questions with regards to the pump installation.

A. Scheduled reviews such as those for testing should be scheduled with the Owner's Representative as required by these specifications.

B. Items to be reviewed by the Owner’s Representative (other review items not listed may occur)
   1. Pump Station Skid placement.
   2. Discharge pipe installation prior to and after concrete thrust blocking.
   3. Transfer pump installation and piping.

C. Impromptu reviews may occur at any time during the project.

D. Final review will occur at the completion of the irrigation pump system installation and Record Drawings.

1.9 GUARANTEE/WARRANTY AND REPLACEMENT

A. The purpose of on-site reviews by the Owner’s Representative is to observe the CONTRACTOR's interpretation of the construction documents and to address questions with regards to the pump installation.

B. Scheduled reviews such as those for testing should be scheduled with the Owner's Representative as required by these specifications.

C. Impromptu reviews may occur at any time during the project.

D. A Final Review will occur at the completion of the irrigation pump system Acceptance Test and Record Drawings. The intent of the Final Review is to verify that all installation; testing; maintenance, operation, and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.

E. All costs, including travel expenses and site visits by the Owner's Representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the CONTRACTOR.
PART 2 MATERIALS

2.1 QUALITY

A. Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

2.2 SUBSTITUTIONS

A. Use specified equipment, or pre-approved equal. Alternative equipment must be approved by Owner’s Representative prior to bidding. Changes and associated design costs to accommodate alternative equipment are Contractor’s responsibility.

B. In making a request for a substitution, the CONTRACTOR represents that they:
   1. Have investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the Owner’s Representative.
   2. Will coordinate the installation and make all modifications to the work, which are required for the complete installation and operation of the system.

C. The Owner’s Representative will determine acceptability of the proposed substitution and will notify CONTRACTOR of acceptance or rejection.

D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the CONTRACTOR.

2.3 GENERAL REQUIREMENTS

A. The transfer pumps shall have a capacity and discharge pressure as shown on the drawings.

B. Construction shall include guide rail system to allow installation and removal of pumps in wet well. Base shall be of sufficient size and strength to resist twisting and bending from hydraulic forces and support the full weight of pumps and motors.

C. The transfer pumps and related equipment shall meet all the general and technical specifications; shall be designed, fabricated and installed in a workmanlike manner; and shall be delivered within the negotiated schedule.

D. Provide a factory-trained technician to supervise the installation of the irrigation pump station and transfer pumps.

   In addition to the time required for installation supervision, the technician shall provide a minimum of 1 day of training for the Owner’s staff in the operation, maintenance, and programming of the irrigation pump system.
E. All irrigation pump station and transfer pump components shall be supplied by and be the responsibility of one manufacturer, even though others manufactured some components.

F. Acceptable Manufacturers:
   1. ITT Flowtronex, 10661 Newkirk Street, Dallas, TX 75220, (800)786-7480. Territory Manager: Chris Dove, (214) 497-9142

2.4 TRANSFER PUMP

A. Submersible transfer pump shall be Ebara or equal as noted in the installation details.

B. Furnish prefabricated, submersible pump station on slide rail assembly with the capacity and design point as shown on the plans and details.

C. The power supply shall be 460 V, 3 phase as shown on the drawings and as required by local utility company. Coordinate with electrical site plans for power connections.

D. All pump station components shall be supplied by and be the responsibility of one manufacturer, even though some components were manufactured by others.

E. The transfer pumps and related equipment shall meet all the general and technical specifications; shall be designed, fabricated and installed in a workmanlike manner; and shall be delivered within schedules negotiated between Contractor and manufacturer.

F. Construction of a quick discharge connector will be such that the pump will automatically be connected to the discharge piping when lowered into place on the discharge connection. The pump shall be easily removable for inspection or service. There shall be no need for personnel to enter the vault for any purpose. The pumping unit shall include 20-ft of machine chain to permit the raising and lowering of the unit. The chain shall be fastened at the top of the structure near the access opening.

G. A sliding guide bracket shall be an integral part of the pumping unit and the pump casing shall have a machined connection with a bracket to connect with the cast iron discharge connection, which shall be bolted to the floor the sump and so designed as to receive the pump connection without the need for any bolts, nuts, or gaskets. Sealing of the pumping unit to the discharge connection shall be accomplished by a single, linear, downward motion of the pump with the entire weight of the pumping unit guided to and wedged tightly against the discharge connection; no portion of the pump shall bear directly on the floor of the sump and no rotary motion of the pump shall be required for sealing.

H. Two guide pipes shall be furnished and installed by the Contractor. They shall permit rising and lowering of the pump. Guide pipes shall be of adequate length
to extend from the lower guide holder on the pump discharge connection to the upper portion of the sump.

I. MOTOR
   1. Submersible pump motor shall be an air filled induction type with a squirrel cage rotor, shell type design, built to NEMA MG-1, Design B specifications. Motor service factor shall be 1.15 and capable of up to 20 starts per hour. The motor shall be designed for continuous duty pumping at a maximum sump temperature of 104 degrees Fahrenheit.
   2. Submersible pump motor power cable jacket shall be manufactured of an oil resistant chloroprene rubber material, designed for submerged applications. Cable shall be watertight to a depth of 65-feet. The cable entry system shall comprise of primary, secondary, and tertiary sealing methods. The cable entry system shall be the same for both the power and control cables.

2.5 PIPE AND FITTINGS

A. Fabricated Piping: All fabricated piping must conform to ASTM specifications A53 for Grade B welded or seamless pipe. Piping 16" and smaller must be Schedule 40. All welding flanges must be forged steel with slip-on or welding neck type. All welding fittings must be seamless, conforming to ASTM Specification A234, with pressure rating not less than 150 psi. Use fabricated ductile iron piping in the wet well unless specified otherwise on the construction documents.

2.6 VALVES

A. Check Valves: Pump wafer-type check valves shall be of the silent operating, non-slam type, cast iron bodied with bronze and stainless steel trim. Sealing surfaces shall utilize resilient Buna N rubber. The valve design shall incorporate a center guided, spring, loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI. Furnish check valves on the discharge of each pump.

2.7 ELECTRICAL

A. Electrical Supply: The power supply to the transfer pumps shall be three phase, 460 volt, 60 hertz, for full voltage across the line motor starting.

2.8 OTHER COMPONENTS

A. Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, and any other items indicated on the drawings.

B. Other Materials: Provide other materials or equipment shown on the drawings or installation details to be part of the pump system, even though such items may not have been referenced in these specifications.
PART 3 EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:
   1. Verify site conditions and note irregularities affecting work of this section.
      Report irregularities to the Owner’s Representative prior to beginning work.
   2. Beginning work of this section implies acceptance of existing conditions.

3.2 PUMPS AND MOTORS

A. Shipping, off-loading and the technical start up shall be furnished by the pump station manufacturer. The pump station manufacturer shall furnish location and mounting details to Owner’s Representative.

B. Anchor pump station to concrete mounting pad and complete all piping connections, per manufacturer’s recommendations, prior to startup and operation of the pump system.

C. Electrical connection shall consist of a single conduit from 3 phase 460 volt disconnect to the pump station main disconnect.

D. Technical start up procedures by the pump station manufacturer shall include the following:
   1. Station start up and pressurization
   2. Pressure, flow, and programming adjustments
   3. Monitoring of irrigation cycle when possible. Technician will instruct operations personnel as to the operation, adjustment and maintenance of the pump station.
   4. Owner and operator training.

3.3 EXCAVATION AND BACKFILLING

A. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Owner’s Representative.

3.4 PUMP SYSTEM INSTALLATION

A. Secure pump skid with all new pumps, motors, and components to concrete floor, pedestal, or pipes and complete all piping connections per manufacturer’s recommendations prior to technical start-up, testing and operation.

3.5 TRANSFER PUMPS INSTALLATION

A. Secure transfer pump guide rails with components to wet well floor and complete all piping connections per manufacturer’s recommendations prior to technical start-up, testing and operation.
3.6 TECHNICAL START-UP

A. Pump system manufacturer must conduct technical start-up of the pump system. Procedures should include:
   1. Pump station start-up and pressurization.
   2. Pressure, flow, automatic shut-down and programming adjustments.
   3. Monitoring of irrigation cycle when possible. Technician will instruct operations personnel as to the operation, adjustment and maintenance of the irrigation pump station.
   4. Transfer pump startup and pressurization. Ensure proper operation of transfer pump and controls.

3.7 INSTALLATION OF SIGNAGE AND IDENTIFICATION

A. Preparation
   1. Degrease and clean surfaces to receive adhesive for identification materials.

B. Installation
   1. Install nameplates and labels only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.
   2. Install nameplates and labels after completion of painting.
   3. Nameplates:
      a. Install nameplate parallel to equipment.
      b. Install nameplates to front of control equipment enclosures, to equipment fronts and to walls using screws or rivets, do not use adhesive.
      c. Install nameplates to inside surface of doors or finished locations using adhesive.
      d. Install nameplates for the following equipment:
         (1) Main pump station: “Main Pump Station Main Electrical Disconnect”
         (2) Main pump station: “Main Pump Control Panel”
         (3) Wet well access hatch: “Wet Well Access Hatch”
   4. Labels:
      a. Install labels parallel to equipment.
      b. Install labels for permanent adhesion and seal with clear lacquer.
      c. Install labels for the following equipment:
         (1) H.O.A. switches located on the main pump control panel: Indicate “H.O.A Switch” plus what each switch operates
         (2) Main pump station control panel user interface: “Main Pump Control Interface”
         (3) Aeration timer switch or controller on the main pump control panel: “Aeration Timeswitch Control”
         (4) Each of the two (2) main vertical turbine pump motors (20 HP), designate #1 and #2:
         (5) Submersible pressure maintenance pump: “PM Pump - 3HP”
         (6) Drain Valves: “Drain Valve”
         (7) Winterization port: “Winterization Port”
         (8) Main pump station discharge pipe: “Main Pump Discharge Pipe” with Flow Directional Arrow
         (9) Main pump station discharge isolation valve: “Main Discharge Isolation Valve”
(10) Pump station lake intake screen flush piping: “Self-cleaning (Rotating) Lake Intake Screen” with Flow Directional Arrow

3.8 OPERATION AND MAINTENANCE MANUALS

A. Furnish four (4) copies of the bound Pump Station Operation and Maintenance manuals as described in the specifications to the Owner’s Representative prior to the start up.

B. Tools and Spare Parts: Prior to the Pre-Maintenance Review, supply to the Owner’s Representative operating keys, servicing tools, test equipment, and any other items indicated on the drawings.

C. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the irrigation pump system, even though such items may not have been referenced in these specifications.

3.9 PROJECT RECORD DRAWINGS

A. The CONTRACTOR is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.

B. Record pump station alterations. Record work, which is installed differently than shown on the construction drawings. Record accurate reference dimensions.

C. A complete wiring circuit and legend with all terminals, components, and wiring identification must be provided on the panel doors.

D. Turn over the Project Documents to the Owner or regulatory authority. Completion of the Project Documents will be a prerequisite for the Review at the completion of the lake recirculation, lake water feature recirculation, lake transfer pipe systems installation.

3.10 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Pump Station Maintenance:

1. Prior to Final Inspection, provide a one-day training session to operating personnel on proper operation and maintenance of the pump station. Training session should be for a period of not less than 8-hours and cover aspects of maintaining, operating and repairing the new pump station.

2. Unless otherwise noted, provide operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
   a. Catalog cut sheets for irrigation pump system.
b. Manufacturer’s Operation and Maintenance manuals including complete documentation for programming and recommended settings and adjustments.

c. Manufacturer’s Technical Service Bulletins.

d. Manufacturer’s Warranty Documentation.

e. Manufacturer’s guide for troubleshooting operational problems.

f. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.

g. Predictive schedule for component replacement.

h. Listing of technical support contacts.

3. Operation and maintenance submittal package must be complete prior to being reviewed by the Owner. Incomplete submittals will be returned without review.

3.11 MAINTENANCE

A. Upon completion of Final Review, maintain system for a duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components as necessary.

B. Following completion of the CONTRACTOR’s maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, and for performing necessary minor maintenance.

3.12 CLEANUP

A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

B. Manufacturer’s Representative shall clean all surfaces and touch up scratches with factory paint to match original.

END OF SECTION
SECTION 32 82 13
PUMPING SYSTEMS INTAKE

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the pump station intake system and well air gap structure and guarantee/ warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

A. Procurement of all applicable licenses, permits, and fees.
B. Provision, excavation, installation, and backfill of pre-cast wet well sections.
C. Provision, excavation, installation, and backfill of wet well intake pipe.
D. Coordination with site work, grading, pump system installation, pump building construction, and any necessary dewatering.

1.2 RELATED SECTIONS

A. 32 82 00 – Vertical Turbine Irrigation Pumping System

1.3 DISCREPANCIES

It is the intent of these plans and specification that the pump system intake be complete and workable. It is the Contractor's responsibility to make sure that the equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Owner or regulatory authority for clarification.

1.4 SUBMITTALS

A. Deliver four (4) copies of submittals to Owner’s Representative within 10 working days from date of Notice to Proceed. Furnish information in 3-ring binder with table of contents and index sheet. Index sections for different components and label with specification section number and name of component. Furnish submittals for components on material list. Indicate which items are being supplied on catalog cut sheets when multiple items are shown on one sheet. Incomplete submittals will be returned without review.

B. Materials List: Include pipe, fittings, and valves. Quantities of materials need not be included.
C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for all equipment supplied.

D. Shop Drawings: Submit shop drawings called for in the installation details or specifications. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.

E. Testing: Submit a proof of testing report following completion of each test listed in the Specifications or Construction Documents. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.

1.5 RULES AND REGULATIONS

A. Work and materials shall be in accordance with the latest edition of the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.

B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.

C. If quantities are provided either in specifications or on these drawings, these quantities are provided for information only. It is the contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

D. Pre-cast concrete wet well drawings from the manufacturer must be signed and sealed by a Professional Engineer.

1.6 TESTING

A. Notify the Owner's Representative five days in advance of testing.
   1. Pipelines jointed with rubber gaskets may be subjected to a test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing. The intake pipe shall be filled with water, raised to test pressure and allowed to stabilize. The test pressure shall be 60 psi for 1 hour. For safety reasons, hydrostatic testing only will be used.
   2. Subsections of intake pipe may be tested independently, subject to the review of the Owner's Representative.
   3. Furnish pumps, labor, fittings, and equipment necessary to conduct tests or retests.
   4. All costs, including travel expenses for site visits by the Owner or regulatory authority, for any re-inspection that may be required due to non-compliance with the Construction Documents shall be the sole responsibility of the Contractor.
B. Pre-cast concrete wet wells:
   1. Obtain geotechnical boring information in the wet well locations. Provide necessary information and recommendations in order to determined necessary backfill material and dry density for proper backfilling. Provide information to precast manufacturer, structural engineer, and contractor.
   2. Conduct compaction testing for every 1-foot of compacted backfill or local code whichever is less. Testing must be completed by an independent agency.
   3. The test results must be provided to the contractor and Owner’s Representative within 1 business day.
   4. If any tested section fails test, the contractor must excavate backfill material and compact per the specifications.

C. Intake Pipe Isolation Gate Valve Assembly:
   1. Complete test prior to installation of pump pad.
   2. Fill pond water level to a minimum depth of 2-feet above top of intake screen in order to perform test.
   3. Install temporary pump in bottom of wet well and pipe discharged water back into pond.
   5. Using pump, lower water elevation in wet well to a minimum of 12-inches below intake pipe invert elevation in wet well.
   6. Leakage past the line gate valve will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
   7. Cement or caulking to seal leaks is prohibited.

1.7 CONSTRUCTION REVIEWS

A. The purpose of on-site reviews by the Owner’s Representative is to observe the Contractor’s interpretation of the construction documents and to address questions with regards to the irrigation pump system intake installation.
   1. Scheduled reviews such as those for testing should be scheduled with the Owner’s Representative as required by these specifications.
   2. Items to be reviewed by the Owner’s Representative (other review items not listed may occur)
      a. Wet well, intake pipe, and self-cleaning intake screen assembly while dry.
   3. Impromptu reviews may occur at any time during the project.
   4. A Final Inspection will occur at the completion of the installation. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
   5. All costs, including travel expenses and site visits by the Owner’s Representative(s) for additional Inspection(s) that may be required after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.
1.8 GUARANTEE/WARRANTY AND REPLACEMENT

The purpose of this guarantee/warranty is to insure that the Owner receives concrete and plumbing materials of prime quality, installed and maintained in a thorough and careful manner.

A. For a period of one year from commencement of the formal maintenance period, guarantee/warranty pump system intake materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner's Representative.

B. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

D. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

PART 2 - MATERIALS

2.1 QUALITY

Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

2.2 SUBSTITUTIONS

A. Use specified equipment, or pre-approved equal. Alternative equipment must be approved by Owner's Representative prior to bidding. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility.

B. In making a request for a substitution, the Contractor represents that they:
   1. Have investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the Owner or regulatory authority.
   2. Will coordinate the installation and make all modifications to the work which may be required for complete installation and operation of the system.

C. The Owner's Representative will determine acceptability of the proposed substitution and will notify Contractor of acceptance or rejection.

D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.
2.2 PRECAST CONCRETE WET WELLS

A. Provide shop drawings showing complete information for the fabrication and installation of the precast concrete sections. Include special reinforcement and lifting devices necessary for handling and erection.

B. Provide layout dimensions, and identification of each precast unit. Detail inserts, connections, blockouts, joints, accessories and openings.

C. Manufacturer of precast concrete units is responsible for design of reinforcement and its placement. Fabricate units with concrete having minimum compressive strength of 4000 PSI at 28 days using Type I-II cement.
   1. Furnish test reports of concrete indicating compressive strength.
   2. Certify that the concrete units fabricated and installed will support the required design loads.

D. Fabricate precast sections in conformance with ASTM C-478 designation for manufacturing, testing, and quality control.

E. Furnish precast units with concrete finish equal to smooth steel formed as-cast concrete. Small surface holes caused by air bubbles, normal form joint marks, minor cracking, chips and spalls, and normal color variations will be permitted.

F. Furnish precast concrete sections manufactured with tongue and groove joints installed with a joint sealant.

G. Provide a water tight seal as described in the Construction Documents.

H. Furnish precast sections with step for access to the wet well. Furnish American Step Company ML-13-NCR step.

I. Furnish shop drawing with Registered Professional Engineers (PE) seal.

2.3 PIPE AND FITTINGS

A. Pipe and Fittings for Pump System Intake:
   1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
   2. Use Class 200, rated at 200 PSI conforming to AWWA Standard C900.

2.4 INTAKE PIPE ISOLATION GATE VALVE ASSEMBLY

A. Furnish gate valve constructed of cast iron with non rising bronze stem, bronze packing gland nut and lift nut, with flanged ends.

B. Furnish valve with optional 2-inch square operating nut.

C. Furnish valve key for valve operating nut.
D. Furnish with valve box, cover, 6-inch PVC pipe section as shown in detail.
E. Furnish gate valve conforming to AWWA C-509.

2.5 FILL MATERIALS

A. Stabilization material
   1. Provide self compacting material as base beneath the wet well per the geotechnical and structural engineer’s requirements.

B. Structural Fill and Backfill
   1. Non-expansive earth materials from on-site excavations meeting the geotechnical and structural engineer’s requirements.
   2. Organic materials, silts, claystone, other bedrock, and high plasticity clays will not be allowed.
   3. Free of trash, glass, broken concrete, or other damaging material.
   4. Free of rocks and stones larger than 2” in size.
   5. Import additional material, if required, using an approved self compacting pit run sand or gravel.

C. Site Fill
   1. Clean, well graded, inorganic earth materials from on-site excavations.
   2. Free of trash, glass, broken concrete, or other damaging material.
   3. Free of gravel, rocks, and stones larger than 2” in size.
   4. For use in areas requiring fill for site grading or landscaping and that are not within ten-feet of structures or 2’ of pavements or sidewalks.

2.6 OTHER COMPONENTS

A. Provide any special tools, operating keys for isolation valves, servicing tools for screen as required.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:
   1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Owner’s Representative prior to beginning work.
   2. Beginning work of this section implies acceptance of existing conditions.

B. Verify locations of underground utilities.

3.2 DRAINAGE, DEWATERING, AND EROSION CONTROL

A. Comply with all Federal, State, and Local Regulations dealing with site drainage, dewatering, and erosion control including permitting requirements.

B. Provide all means necessary to accomplish drainage, dewatering, and erosion control required for completion of the project.
C. Provide drainage control measures to prevent surface runoff from entering excavations.

D. Manage all surface water and pumped water to minimize sediment transport.

E. Dewater each excavation area to lower the ground water level to a minimum of two feet below the bottom of the excavation prior to excavation.

F. Maintain the lowered ground water level and keep excavations free of standing water until the construction is completed to the extent that no damage to the subgrade, structure, or other work will result from hydrostatic pressure, flotation, or seepage.

G. Use sumps, gravel blankets, well points, drainage lines, or other means necessary to accomplish the above.

3.3 SHEETING AND SHORING

A. Use sheeting and shoring where banks are not cut back on a stable slope and as necessary to prevent caving or sliding; and to protect the work and adjacent structures and facilities. All work shall conform to current applicable regulations.

B. Sheet ing and shoring must be designed by a Registered Professional Engineer, in the State where work is being performed, to withstand all applicable earth, surcharge, and hydrostatic loads and must be built and maintained in accordance with the design.
   1. Provide shop drawings for system designed and sealed by Professional Engineer.

C. Support sheeting to avoid load concentration or horizontal thrust on underground structures.

D. Sheet ing removal:
   1. Do not remove prior to backfilling.
   2. Use effective methods to protect construction, other structures, utilities, and properties during sheeting removal.
   3. Fill voids left by sheeting removal with dry sand.

E. Weather:
   1. Do not construct fills or embankments during freezing weather.
   2. Do not construct fills on frozen surfaces.
   3. Do not construct fills in water.
   4. Do not place frozen materials, snow, or ice in fill materials.
   5. Structures must not be placed on frozen subgrades.

3.4 BASE

A. Place a minimum of 12" of stabilization material where noted on the drawings and where required for leveling of subgrade.
B. Compact in six inch lifts by two passes of plate compactor or steel drum roller.

C. Cover top surface with 6 mil or thicker polyethylene film with concrete is to be cast on top of stabilization material.

3.5 EXCAVATION, TRENCHING, AND BACKFILLING

A. Comply with all Federal, State, and Local requirements for safety and permitting.
   1. Provide adequate space and clearances for project work.
   2. Do not undercut excavated faces.
   3. Excavations must result in firm, undisturbed subgrades.
   4. Do not drive excavation equipment or other vehicles on subgrades that rut, pump, or become unstable under traffic.

B. Excavate to permit the pipes and the precast wet well to be set at the intended elevations and to permit work space for installing connections and fittings.

C. Minimum cover (distance from top of pipe to finish grade) per installation details.
   1. Provide 24-inches over intake screen backwash pipe.

D. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the Owner’s Representative.

E. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe.

F. Backfill pipe in either of the following manners:
   1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
   2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to the density of surrounding soil.

G. Backfill pre-cast concrete wet well in following manner:
   1. Backfill the area around the wet well by depositing the backfill material equally around the circumference / perimeter of the pre-cast wet well in 6-inch lifts and compacting to 95% Standard Proctor Density (SPD).

H. Dress backfilled areas to meet final grade. Incorporate excess backfill into existing site grades.

3.6 PRECAST CONCRETE

A. Coordinate exact location of fixtures with Architect prior to installation.

B. Install units on a 6-inch gravel subbase over compacted subgrade in accordance with manufacturer's instructions.
C. Lift, place, and secure units in accordance with manufacturer's instructions and final shop drawings. Do not install units until supporting members are in place and secured.
   1. Lift only at lifting points provided and install temporary shoring and bracing as necessary.
   2. Level units accurately and in acceptable condition to allow installation of subsequent work.
   3. Grout all joints and repair damaged exposed surfaces as required.

3.7 ASSEMBLING PIPE AND FITTINGS

A. General:
   2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
   3. Join pipe according to industry standards and manufacturer's recommendation.

B. Pipe and Fittings:
   1. PVC intake pipe: Join pipe lengths as recommended by the manufacturer.

3.8 INSTALLATION OF INTAKE PIPE ISOLATION GATE VALVE ASSEMBLY:

A. Install where indicated on drawings and confirmed by the Owner's Representative.

B. Install per manufacturer's recommendations.

C. Install operating extension, valve box and cover as shown in installation details and as recommended by the manufacturer.

3.9 MAINTENANCE AND OPERATION INSTRUCTIONS:

A. Irrigation Pump Intake System Maintenance:
   1. In conjunction with the pump station training, provide training on proper operation and maintenance of the pump system intake.
   2. In conjunction with the pump station operation and maintenance information, provide the following information:
      a. Catalog cut sheets.
      b. Manufacturer's Operation and Maintenance manuals including complete documentation for programming and recommended settings and adjustments.
      c. Manufacturer's Technical Service Bulletins.
      d. Manufacturer's Warranty Documentation.
      e. Manufacturer's guide for troubleshooting operational problems.
      f. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
g. Predictive schedule for component replacement.
h. Listing of technical support contacts.

3. Operation and maintenance submittal package must be complete prior to being reviewed by the Owner’s Representative. Incomplete submittals will be returned without review.

3.10 INSTALLATION OF OTHER COMPONENTS

A. Tools: Prior to the Final Review, supply to the Owner’s Representative, operating keys, servicing tools, and any other items indicated on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the pump intake system, even though such items may not have been referenced in these specifications.

3.11 PROJECT RECORD (AS-BUILT) DRAWINGS

A. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.

B. Record pipe alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points.

C. Turn over the Project Documents to the Owner or regulatory authority. Completion of the Project Documents will be a prerequisite for the Review at the completion of the lake recirculation, lake water feature recirculation, lake transfer pipe systems installation.

3.12 CLEANUP

A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

B. Remove all debris and foreign material from the construction area and wet well.

END OF SECTION
PART 1 GENERAL

1.1 SCOPE OF WORK

This specification describes the construction of an automatic lake aeration system for an irrigation pond. All components of the aeration system including compressor, electrical controls, valves, prefabricated pipe manifolds, flow meters, gauges, lake aeration tube, and all other items necessary for the proper assembly and operation of the system must be provided by a single supplier as a "knocked down" aeration system. The intent is to provide responsibility for the materials, installation, and warranty of the system.

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the aeration system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

A. Procurement of all applicable licenses, permits, and fees as required by local codes and utilities.

B. Coordination of Utility Locates.

C. Connection of electrical power supply from the irrigation pump station to the aeration system.

D. Installation of compressor, air-cooled after cooler, connection to electrical controls, piping, valves, aeration feeder/distribution tubing, aeration modules, and appurtenances necessary for the complete operation of the lake bottom aeration system.

E. Coordination of installation of aeration mechanical system with the installation of the pump system concrete mounting pad and building enclosure, conduit penetrations, the building wall surrounding the equipment, and the access door.

F. Testing and start-up, and adjustment of aeration system.

G. Maintenance period.

1.2 RELATED SECTIONS.

A. 32 82 00 – Vertical Turbine Irrigation Pumping System

1.3 DISCREPENCIES

It is the intent of these plans and specification that all equipment installed within the pump building is complete and workable. It is the CONTRACTOR’s responsibility to
make sure all equipment furnished is compatible and adheres to all regulations. Any discrepancies should be noted immediately and should be reported to the Owner’s Representative for clarification.

1.4 SUBMITTALS

A. Deliver four (4) copies of submittals to Owner’s Representative within 10 working days from date of Notice to Proceed. Furnish information in 3-ring binder with table of contents and index sheet. Index sections for different components and label with specification section number and name of component. Furnish submittals for components on material list. Indicate which items are being supplied on catalog cut sheets when multiple items are shown on one sheet. Incomplete submittals will be returned without review.

B. Materials List: Include pipe, tubing, valves, flow meters, fittings, compressor, control system components, and electrical equipment. Quantities of materials need not be included.

C. Manufacturers’ Data: Submit manufacturers' catalog cuts, specifications, and operating and maintenance instructions for all equipment supplied.

D. Maintenance Manual: Submit four copies of a bound maintenance manual that includes all manufacturer's data listed above and recommended operating procedures, adjustments, system trouble shooting, and preventive maintenance procedures.

E. Shop Drawings: Submit shop drawings of compressor system, electrical controls, and flow meter control unit installation. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation drawings.

F. Testing: Submit a proof of testing report following completion of each test listed in the Specifications or Construction Documents. Unless otherwise noted, include name of test, date of test, name of individual completing the test, name of the company completing the test and a summary of the test results. If the system fails test, document any and all retests until system passes test.

1.5 RULES AND REGULATIONS

A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.

B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
1.6 TESTING

A. Notify the Owner’s Representative three days (72 hours) in advance of testing.

B. On completion of assembly, the aeration system piping shall be hydrostatically tested at a pressure not less than 50 PSI.

C. Control and safety shut off devices shall be tested and verified operational.

D. Flow and discharge pressure shall be verified with specified values.

E. All costs, including travel expenses and site visits by the Owner or regulatory authority, for any re-inspection that may be required due to non compliance with the Construction Documents shall be the sole responsibility of the CONTRACTOR.

1.7 CONSTRUCTION REVIEWS

The purpose of on-site reviews by the Owner or regulatory authority is to observe the CONTRACTOR’s interpretation of the construction documents and to address questions with regards to the installation of the aeration system.

A. Scheduled reviews such as those for testing should be scheduled with the Owner or regulatory authority as required by these specifications.

B. Items to be reviewed by the Owner’s Representative (other review items not listed may occur)
   1. Pond aeration pod placement and location.

C. Impromptu reviews may occur at any time during the project.

D. Final observation will occur upon request of the Owner’s Representative and prior to final acceptance. The intent is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.

E. All costs, including travel expenses and site visits by the Owner or regulatory authority for additional Inspection(s) that may be required after the Final Observation due to non-compliance with the Construction Documents are the sole responsibility of the CONTRACTOR.

1.8 GUARANTEE/WARRANTY AND REPLACEMENT

The purpose of this guarantee/warranty is to insure that the Owner’s Representative receives materials of prime quality, installed and maintained in a thorough and careful manner.

A. The manufacturer shall warrant the aeration system to be free of defects and product malfunctions for a period of one year from date of start up. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of trenches or excavations. Repair damage to the premises caused by a defective
item. Make repairs within seven days of notification from the Owner’s Representative.

B. Failures caused by lightning strikes, power surges, vandalism, flooding, operator abuse, or acts of God are excluded from warranty coverage.

C. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Owner’s Representative.

D. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

E. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

PART 2 MATERIALS

2.1 QUALITY

Materials used in the system shall be new and without flaws or defects of any type, and shall be the best of their class and kind.

2.2 SUBSTITUTIONS

A. Use specified equipment, or pre-approved equal. Alternative equipment must be approved by Owner’s Representative prior to bidding. Changes and associated design costs to accommodate alternative equipment are Contractor’s responsibility.

B. In making a request for a substitution, the CONTRACTOR represents that he:
   1. Has investigated the proposed substitution and found that it is the same or better quality, level, capacity, function, or appearance than the specified product, and can demonstrate that to the Owner or regulatory authority.
   2. Will coordinate the installation and make all modifications to the work which may be required for complete installation and operation of the system.

C. The Owner’s Representative will determine acceptability of the proposed substitution and will notify CONTRACTOR of acceptance or rejection.

D. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the CONTRACTOR.

2.3 GENERAL REQUIREMENTS

A. The aeration system must have a minimum capacity as shown in the drawings.

B. The aeration system includes an oilless piston compressor, air cooled air after cooler, flow meters, gauges, fittings, valves, and piping as required and as shown on the drawings and details.
C. Completely assemble and operate all components of the aeration system prior to shipment to insure proper fit, assembly and operation on the job site.

D. Construction must include all necessary components and vibration dampeners to support all components during shipping and to serve as the installed mounting base on the concrete slab.

E. Connection of the aeration system to electrical power supply on the pump station per the electrical Construction Documents.

F. All system components shall be supplied and be the responsibility of one manufacturer, even though some components were manufactured by others.

G. The aeration system and related equipment shall meet all the general and technical specifications; shall be designed, fabricated and installed in a workmanlike manner; and shall be delivered within schedules negotiated between CONTRACTOR and manufacturer.

H. In addition to the time required for installation supervision, the technician shall provide a minimum of 1 day of training for the Owner’s Representative’s staff in the operation, maintenance, and programming of the aeration system.

I. Furnish shop drawing for approval prior to installation.

J. Acceptable Manufacturers Representative:
   1. Aqua Sierra, Inc. Contact: Bill Logan, Aqua Sierra, Inc., 8350 South Mariposa Drive, Morrison, Colorado, 80465, (303) 697-5486

2.4 COMPRESSOR SYSTEM

K. Furnish an air cooled, dry running, non-contacting, positive displacement pressure pump using an oilless piston design. Approved manufacturers/models are Gast 7L, or approved equal.
   1. Provide pressure pump with a minimum 8 CFM flow rate at a 7.6 PSI discharge pressure.
   2. Provide all electrical controls. Motor electrical requirement is 115/208-230V, 60 Hz, single phase.
   3. Equip compressor with air inlet filter and silencer.
   4. The timeswitch control system for the aeration compressor is to be integrated into the main vertical turbine pump station control panel. Refer to Specification Section 32 82 00 for additional information.
   5. Furnish automatic drain valve, safety relief valve, pressure gauges, and necessary valves and piping.
2.5 AIR-COOLED AFTER COOLER

A. Furnish air cooled air after cooler with 1/6 HP fan and aluminum fin heat exchanger designed for continuous duty operation. Approved manufacturer and model is Pioneer Air Systems AH75, Thermal Transfer Products Model UPA-100-S-100AD with separator, Speedaire, Van Aire Systems or approved equal.
   1. Flow rate: 75 SCFM at 350°F inlet at 20°F approach.
   2. Motor HP: 1/6 HP, 115 VAC, single phase, 1550 RPM.

B. The air cooled after cooler must operate while the compressor system is activated. Operation is to be initiated by the same time switch control system that activates the aeration compressor. This time switch controller is to be integrated into the main vertical turbine pump station control panel. Refer to Specification Section 32 82 00 for additional information.

2.6 CONDENSATE SEPARATOR

A. Furnish condensate separator with automatic drain sized as necessary at low point in system downstream of air cooled air after cooler.

2.7 PIPING

A. Compressor Piping: Use high temperature (rated at -325° F to 1250° F), stainless steel, braided industrial air & water hose or SCH 40 galvanized steel pipe between the compressor and air cooled air after cooler. If galvanized steel pipe is used, vibration isolation flexible fittings must be provided.

B. Use high temperature (rated at -325° F to 1250° F), stainless steel, braided industrial air & water hose or SCH 40 galvanized steel pipe between for all piping between air cooled air after cooler and manifold piping. If galvanized steel pipe is used, vibration isolation flexible fittings must be provided.

C. Manifold Piping: Use SCH 40 galvanized steel pipe for manifold to flow meters and control valves.

D. Aeration Hose: Use industrial grade hose for all above grade piping between the flow meters and aeration tubing. Approved manufacturer is Gates Adapta Flex Industrial Hose or equal.
   1. Hose must be suitable for air and water applications with heat and ozone resistance.
   2. Temperature range: -40°F to 200°F continuous service rating.
   3. Tube and cover construction material: Type P (EPDM), black.
   4. Reinforcement: Synthetic, high tensile textile cord.
   5. Fasteners: Must be constructed of stainless steel with a minimum pressure rating equal to the piping pressure rating.
E. Aeration Tubing: Use 3/4-inch, DR-11 High Density Polyethylene (HDPE) piping for all below grade tubing between the aeration hose and transition to air distribution tubing at lake edge.
1. Hose must be suitable for air and water applications.
2. Fasteners: Must be constructed of stainless steel with a minimum pressure rating equal to the piping pressure rating.

F. Air Distribution Tubing
1. Furnish 100 PSI 3/4-inch high density flexible PVC between aeration tubing at lake edge to lake aeration modules at lake bottom. Locate splice connection in 12-inch valve boxes.
2. Use non-leaded, self-weighted high density flexible PVC between aeration piping at lake edge and aeration modules as shown on the drawings.
3. Tubing ID = 0.75” and specific gravity (SG) = 1.55.

G. Lake Aeration Modules: Furnish aeration modules for installation on the bottom of the lake per the Construction Documents. Module must have necessary internal ballast to stay properly placed on the lake bottom.
2. Furnish disc type 12-inch membrane diffusers only. Odd sizes and cylindrical diffusers are not acceptable.
3. Diffuser to consist of a membrane with integral gasket, base, retaining ring, air flow control orifice of 2/5” for 12” discs, and saddle. Diffusers with ceramic or plastic type diffusion media elements are not acceptable as alternatives to the membrane. Diffusers without a high performance fluoroelastomer sacrificial barrier layer such as PTFE or VITON® are not acceptable. Diffusers that require a center bolt or webbing to limit membrane deflection are not acceptable.
4. Diffuser to have two connection methods to pipe. Threaded ¾” connection to grommet or threaded pipe.
5. Membrane material to be premium quality compression molded EPDM with an oil content of less than 13%. Membranes which are injection molded are not acceptable. Membrane shall collapse and seal when aeration system air is turned off.
6. Membrane shall collapse onto base when air is not being diffused. Design should permit air to exit through the entire periphery of the membrane. Membrane shall be designed to resist clogging.
7. Diffuser base and retaining ring to be constructed of polypropylene with organic UV stabilizers and anti-bacterial agents to prevent bacterial buildup & ease future membrane replacement. Plastics that do not utilize UV protection are not acceptable.

H. Piping Hardware: Furnish stainless steel clamps, fittings, supports, and gaskets as required for all piping and tubing connections.
2.8 VALVES

A. Check Valve: Furnish stainless steel check valve downstream of each compressor.

B. Isolation Valve: Furnish stainless steel ball valve for isolation of compressor.

C. Regulating Control Valve: Furnish stainless steel ball valves where indicated in on aeration flow diagram detail.

2.9 GAUGES

A. Furnish 2.5-inch diameter liquid filled or vibration/pulsation dampened pressure gauges. Install stainless steel ball valves to provide total isolation of pressure gauges.

2.10 FLOW METERS

A. Furnish flow meters, located on each lateral pipe, for each lake aeration module. Flow range shall be 0 to 16 CFM (0 to 1000 SCFH). Acceptable manufacturers are Dwyer and Blue-White Industries.

B. Label each flow meter with the associated module and location of the module in the lake. Provide a diagram of the modules showing location and label to match the flow meters.

2.11 PRESSURE TRANSDUCER

A. Furnish pressure transducer/transmitter with a pressure rating exceeding the normal operating pressure of the aeration system and compatible with the aeration control system.

2.12 ELECTRICAL

A. Electrical services, disconnects, and motor starters for the aeration compressor and air cooled air after cooler systems are to be integral to the main vertical turbine pump station controls and control panel. Refer to Specification Section 32 82 00 for additional information.

B. Aeration System Wiring:
   1. All wiring from control panel to compressor shall be in liquid-tight conduit with copper conductors rated not less than 600 volts AC and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductor. A grounding cable shall be included in the liquid-tight conduit. Splices between the motor starters and the motor connection boxes are not allowed.
   2. Furnish multi-conductor shielded cable suitable for Class II low voltage controls for wiring to flow sensors.
C. Standards:
1. All wiring shall conform to the National Electrical Code Standards.
2. Flexible conduit sections shall be under 5 feet in length to meet code. All conduit to devices shall be attached securely to avoid trip hazards.
3. A wiring schematic shall be provided by the manufacturer for approval prior to manufacture. The schematic shall show all devices, connections and wire numbers. Furnish a laminated copy of the schematic attached to the interior door of the panel.

2.13 PAINTING

Painting of the entire unit shall consist of a multi-step coating system which includes metal preparation, rust inhibitive prime coat, and a two part catalyzed acrylic finish having a total dry film thickness of not less than 4 mils. Paint aeration system components with the manufacturer's standard color.

2.14 SIGNAGE AND IDENTIFICATION

A. Nameplates:
1. Provide and install nameplates, minimum 1/8” thickness, composed of laminated three-layer plastic with engraved black letters on white contrasting background.
2. Use 1/2-inch high stenciled letters for identifying equipment.

B. Labels:
1. Provide and install labels on embossed adhesive tape with black letters on white contrasting background.
2. Use ½-inch high letters for identifying equipment.

2.15 OTHER COMPONENTS

A. Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, and any other items indicated on the drawings.

B. Other Materials: Provide other materials or equipment shown on the drawings or installation details to be part of the aeration system, even though such items may not have been referenced in these specifications.

PART 3 EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:
1. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
2. Beginning work of this section implies acceptance of existing conditions.
3.2 AERATION SYSTEM INSTALLATION

A. Shipping, off-loading and the technical start up shall be furnished by the aeration system manufacturer. Location and mounting details shall be furnished to the CONTRACTOR by the aeration system manufacturer.

B. Coordinate the installation of the aeration system with the installation of the irrigation pumping system and the construction of the pump station building referenced in other sections of the specifications.

C. Install the system as recommended by the manufacturer and as shown in the drawings. Make all connections and adjustments necessary for the proper operation of the aeration system.

D. Install compressor, filters, coolers, flow meters, valves, pressure gauges, and pipe including copper manifolds, sleeves, air distribution pipe, and lake aeration tube.
   1. Install flow meters and control valves in the pump station building and not at the lake edge. Each module should have a “home run” of tubing between the aeration device and flow meter in the enclosure.
   2. Install all tubing and piping as shown on plans and as recommended by the manufacturer.
   3. Make connection between air distribution tubing and lake aeration modules where shown on plans and as recommended by the manufacturer.
   4. Install sleeving where indicated on the drawing. Coordinate the installation of the lake edge sleeves with the installation of the trench wall and the lake liner and seal all penetrations as recommended by the manufacturer.
   5. Install aeration piping at a minimum depth of 24-inches when not installed in sleeving.

E. Technical start up procedures by the aeration system manufacturer shall include the following:
   1. Provide detailed written start-up procedure to Owner’s Representative for review a minimum of five (5) working days prior to start-up.
   2. System start-up and pressurization of aeration piping system.
   3. Pressure, flow, and balance adjustments.

3.3 INSTALLATION OF ELECTRICAL COMPONENTS

A. Install all conduit and wiring as recommended by the manufacturer and as necessary for the proper operation of the system.

3.4 AERATION SYSTEM TECHNICAL START-UP

A. Aeration system manufacturer must conduct technical start-up of aeration system. Procedures should include:
   1. Provide detailed, written start-up procedure for Owner’s Representative for review five (5) working days prior to start-up.
   2. System start-up and pressurization of aeration piping system.
   3. Pressure, flow, and balance adjustments.
3.5 PAINTING

A. Paint all bare metal surfaces to match paint as applied by pump system manufacturer. Touch up all dings and scratches as required.

3.6 INSTALLATION OF SIGNAGE AND IDENTIFICATION

A. Preparation
   1. Degrease and clean surfaces to receive adhesive for identification materials.

B. Installation
   1. Install nameplates and labels only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.
   2. Install nameplates and labels after completion of painting.
   3. Nameplates:
      a. Install nameplate parallel to equipment.
      b. Install nameplates to front of control equipment enclosures, to equipment fronts and to walls using screws or rivets, do not use adhesive.
      c. Install nameplates to inside surface of doors or finished locations using adhesive.
      d. Install nameplates for the following equipment:
         (1) Install two (2) nameplates reading “Caution: Hot Pipes Do Not Touch”, one each side of the aeration system manifold approximately 4-1/2-feet off finish floor elevation.
   4. Labels:
      a. Install labels parallel to equipment.
      b. Install labels for permanent adhesion and seal with clear lacquer.
      c. Install labels for the following equipment:
         (1) Aeration compressor: “Aeration System Compressor”
         (2) Air-cooled after-cooler: “Air-Cooled After-Cooler”
         (3) Condensate separator: “Condensate Seperator”
         (4) Flow meters with the associated lake module number
         (5) Flow regulation control valves with the associated lake module number (match flow meter number)

3.7 OTHER ITEMS

A. Tools and Spare Parts:
   1. Prior to the Final Review, supply to the Owner’s Representative operating keys, servicing tools, test equipment, and any other items indicated on the drawings.
   2. Prior to Final Review, supply to the Owner’s Representative one complete set gaskets for each compressor. Furnish other spare parts indicated in the General Notes on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details to be part of the aeration system, even though such items may not have been referenced in these specifications.
3.8 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be furnished at time of start up.

3.9 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Aeration System Maintenance:

1. Prior to Final Inspection, provide a one-day training session to operating personnel on proper operation and maintenance of the aeration system. Training session should be for a period of not less than 4-hours and cover aspects of maintaining, operating and repairing the new aeration system.

2. Unless otherwise noted, provide aeration system operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
   a. Catalog cut sheets for aeration system.
   b. Manufacturer’s Operation and Maintenance manuals including complete documentation for programming and recommended settings and adjustments.
   c. Manufacturer’s Technical Service Bulletins.
   d. Manufacturer’s Warranty Documentation.
   e. Manufacturer’s guide for troubleshooting operational problems.
   f. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
   g. Predictive schedule for component replacement.
   h. Listing of technical support contacts.
   i. Operation and maintenance submittal package must be complete prior to being reviewed by the Owner’s Representative. Incomplete submittals will be returned without review.

3.10 PROJECT RECORD (AS-BUILT) DRAWINGS

A. Submit Record Drawings prior to final review.

B. Maintain one set of contract documents as Project Documents. Locate on-site and separate from documents used for construction. Keep documents current. Do not permanently cover work until as-built information is recorded.

C. Record pipe system alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions from a minimum of two fixed locations.

D. Turn over the Project Documents to the Owner or regulatory authority. Completion of the Project Documents will be a prerequisite for the Review at the completion of the lake recirculation, lake water feature recirculation, lake transfer pipe systems installation.
3.11 MAINTENANCE

A. Upon completion of Final Review, maintain system for a duration of 30 calendar days. Make periodic examinations and adjustments to aeration system components as necessary.

B. Following completion of the CONTRACTOR’s maintenance period, the Owner’s Representative will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, and for performing necessary minor maintenance.

3.12 CLEANUP

A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

B. CONTRACTOR shall clean all surfaces and touch up scratches with factory paint to match original.

END OF SECTION
PART 1 GENERAL

1.1 SCOPE

Provide labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:

A. Procurement of applicable licenses, permits, and fees.
B. Coordination of Utility Locates ("Call Before You Dig").
C. Sleeving for irrigation pipe and wire.
D. Preparation of Record Drawings.
E. Winterization and Spring Start-up
F. Maintenance period.

1.2 QUALITY ASSURANCE

A. Installer Qualifications - Installer shall have had considerable experience and demonstrate ability in the installation of irrigation system(s) of specific type(s) in a neat orderly and responsible manner in accordance with recognized standards of workmanship. To demonstrate ability and experience necessary for this Project, and financial stability, submit if requested by Owner’s Representative, prior to contract award the following:

1. List of 3 projects completed in the last 2 years of similar complexity to this Project. Description of projects shall include:
   a. Name of project.
   b. Location.
   c. Owner.
   d. Brief description of work and project budget.
2. Current company financial statement.

B. Special Requirements:

1. Work involving substantial plumbing for installation of copper piping, backflow preventer(s), and related Work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.
2. Tolerances - Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, compaction, and repair of finish grade treatment.
3. Coordination With Other Contractors - Protect, maintain, and coordinate Work with Work under other Sections.

4. Damage To Other Improvements - Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Sections during Work associated with installation of irrigation system at no additional cost to Owner.

C. Pre-Construction Conference - Contractor shall schedule and conduct a conference to review in detail quality control and construction requirements for equipment, materials, and systems used to perform the Work. Conference shall be scheduled not less than 10 days prior to commencement of Work. All parties required to be in attendance shall be notified no later than 7 days prior to date of conference. Contractor shall notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to Architect, Consultant, Contractor's Superintendent, and Installer.

1. Minutes of conference shall be recorded and distributed by Contractor to all parties in attendance within five days of conference.

1.3 SUBMITTALS

A. Deliver four (4) copies of submittals to Owner's Representative within 10 working days from date of Notice to Proceed. Furnish information in 3-ring binder with table of contents and index sheet. Index sections for different components and label with specification section number and name of component. Furnish submittals for components on material list. Indicate which items are being supplied on catalog cut sheets when multiple items are shown on one sheet. Incomplete submittals will be returned without review.

B. Materials List: Include sleeving, pipe, fittings, sprinklers, mainline components, shop drawings and other components shown on drawings and installation details or described herein. Include pipe sealant, wire, wire connectors, ID tags, and other miscellaneous items. Quantities of materials need not be included.

C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on materials list.

D. Shop Drawings: Submit shop drawings called for in installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to installation detail.

E. Operation Instructions - Submit 3 written operating instructions including winterization procedures and start-up, with cut sheets of products, and coordinate controller/watering operation instruction with Owner maintenance personnel.

1.4 DELIVERY, STORAGE, AND HANDLING - Deliver, unload, store, and handle materials, packaging, bundling, products in dry, weatherproof, condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism. Deliver in original unopened packaging containers prominently displaying manufacturer's name, volume, quantity, contents, instructions, and conformance to local, state, and federal law. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.
A. Handling of PVC and HDPE Pipe - Exercise care in handling, loading and storing, of PVC and HDPE pipe. All PVC and HDPE pipe shall be transported in a vehicle which allows length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads. All sections of pipe that have been dented or damaged shall be discarded, and if installed, shall be replaced with new piping.

1.5 JOBSITE CONDITIONS:

A. Protection of Property:
1. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to Work of this Section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to satisfaction of Owner, and all injury to living plants shall be repaired by Owner. All costs of such repairs shall be charged to and paid by Contractor.

2. Protect buildings, walks, walls, and other property from damage. Flare and barricade open ditches. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at no cost to Owner. Restore disturbed areas to original condition.

B. Existing Trees:
1. All trenching or other Work under limb spread (dripline) of any and all evergreens or deciduous material shall be done by hand or by other methods so as to prevent damage to root system.

2. Prune any branches of trees to be preserved which may be damaged by construction.

3. Where it is necessary to excavate adjacent to existing trees use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2 inch and larger roots occur, shall be done by hand. Roots 2 inches or larger in diameter, except directly in the path of pipe of conduit, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Where a trenching machine is operated close to trees having roots smaller than 2 inches in diameter, wall of trench adjacent to tree shall be hand trimmed, making clean cuts through roots. Trenches adjacent to trees shall be closed within 24 hours, and when this is not possible, side of trench adjacent to tree shall be kept shaded with moistened burlap or canvas.

C. Protection and Repair of Underground Lines:
1. Request proper utility company to stake exact location (including depth) of all underground electric, gas, or telephone lines. Take whatever precautions are necessary to protect these underground lines from damage. If damage does occur, all damage shall be repaired by Utility Owner. All costs of such repairs shall be paid by Contractor unless other arrangements have been made.

2. Request Owner, in writing, to locate all private utilities (i.e., electrical service to outside lighting) before proceeding with excavation. If, after such request and necessary staking, private utilities which were not staked are encountered and damaged by Installer, they shall be repaired by Owner at no cost to Installer. If Contractor damages staked or located utilities, they shall be repaired by Utility Owner at Contractor's expense unless other arrangements have been made.
D. Replacement of Paving and Curbs - Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and shall be restored to original condition.

1.6 RULES AND REGULATIONS

A. Provide work and materials in accordance with latest edition of National Electric Code, Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws, regulations and codes of governing authorities.

B. When contract documents call for materials or construction of better quality or larger size than required by above-mentioned rules and regulations, provide quality and size required by contract documents.

C. If quantities are furnished either in specifications or on drawings, quantities are furnished for information only. It is Contractor's responsibility to determine actual quantities of material, equipment, and supplies required by the project and to complete independent estimate of quantities and wastage.

D. Notify engineer in writing prior to construction about discrepancies between contract documents and existing site conditions or manufacturer's specific recommendations for use of their product.

1.7 TESTING

A. Schedule testing with Owner's Representative a minimum of three days in advance of testing.

B. Mainline pipe jointed with rubber gaskets or threaded connections may be subjected to pressure test at any time after partial completion of backfill. Allow irrigation pipe jointed with solvent-welded PVC joints to cure at least 24 hours before testing.

C. Subsections of mainline pipe may be tested independently, subject to review of Irrigation Engineer.

D. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.

E. Volumetric Leakage Test:
   1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
   2. Purge air from pipeline before test.
   3. Subject mainline pipe to 120 PSI for two hours. Maintain constant pressure.
   4. Provide all necessary pumps, bypass piping, storage tanks, meters, 3-inch test gauge, supply piping, and fittings in order to properly perform testing.
   5. Testing pump must provide a continuous 120-PSI pressure to the mainline pipe. Allowable deviation in test pressure is 5-PSI during test period. Restore test pressure to 120-PSI at end of test.
   6. Water added to mainline pipe must be measured volumetrically to nearest 0.10 gallons.
   7. Use following table to determine maximum allowable volume lost during test:
Leakage Allowable (Gallons per (100 Joints) / Hour)

<table>
<thead>
<tr>
<th>PIPE SIZE (INCHES)</th>
<th>Test Pressure (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
</tr>
<tr>
<td>2 ½&quot;</td>
<td>0.26</td>
</tr>
<tr>
<td>3&quot;</td>
<td>0.31</td>
</tr>
<tr>
<td>4&quot;</td>
<td>0.42</td>
</tr>
<tr>
<td>6&quot;</td>
<td>0.63</td>
</tr>
<tr>
<td>8&quot;</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Note: Allowable Leakage calculated using $L = \frac{(ND\sqrt{P})}{7400}$
Where: $L = \text{Allowable Leakage (gph)}$
$N = \text{Number of Joints}$
$D = \text{Nominal Diameter of Pipe (inches)}$
$P = \text{Average Test Pressure (psi)}$

8. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pipe passes test.
9. Cement or caulking to seal leaks is prohibited.
10. Contractor may sub-contract testing to pipeline testing company approved by Owner.

F. Communication:
  1. Test for leaks to ground per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
  2. Test cable for continuity if cable is being installed for future expansion of the irrigation system.
  3. Replace defective wire, underground splices, or appurtenances. Repeat test until manufacturer's guidelines are met.

1.8 CONSTRUCTION REVIEW

The purpose of on-site reviews by Owner's Representative is to periodically observe work in progress, Contractor's interpretation of construction documents, and to address questions with regard to installation.

A. Schedule reviews for irrigation system layout or testing with Owner's Representative as required by these specifications.

B. Impromptu reviews may occur at any time during project.

C. All change in directions requiring mainline thrust blocks are to be reviewed by Owner's Representative prior to backfill.

D. All mainline connections to existing irrigation systems are to be reviewed by Owner's Representative prior to backfill.
E. Walk-Through for Substantial Completion:
   1. Arrange for Owner’s Representative presence 48 hours in advance of walk-through.
   2. Entire system shall be completely installed and operational prior to scheduling of walk-through.
   3. Operate each zone in its entirety for Owner’s Representative at time of walk-through and additionally, open all valve boxes if directed.
   4. Generate a list of items to be corrected prior to Final Completion.
   5. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.

F. Walk-Through for Final Completion:
   1. Arrange for Owner’s Representative presence 48 hours in advance of walk-through.
   2. Show evidence to Consultant that Owner has received all accessories, charts, record drawings, and equipment as required before Final Completion walkthrough is scheduled.
   3. Items deemed not acceptable by Owner’s Representative shall be reworked to complete satisfaction of Owner’s Representative.
   4. If after request to Owner’s Representative for walk-through for Final Completion of irrigation system, if Owner’s Representative finds items during walk-through which have not been properly adjusted, reworked, or replaced as indicated on list of incomplete items from previous walk-through, Contractor shall be charged for all subsequent walk-throughs. Funds will be withheld from final payment and/or retainage to Contractor, in amount equal to additional time and expenses required by Consultant to conduct and document further walk-throughs as deemed necessary to insure compliance with Contract Documents.

G. Areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at no additional cost to the Owner.

1.9 GUARANTEE/WARRANTY AND REPLACEMENT

The purpose of guarantee/warranty is to ensure that Owner receives irrigation materials of prime quality, installed and maintained in thorough and careful manner.

A. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for period of one year from formal written acceptance by Owner’s Representative. Fill and repair depressions. Restore landscape, utilities, structures and site features damaged by settlement of irrigation trenches or excavations. Repair damage to premises caused by defective items. Make repairs within seven days of notification from Owner’s Representative.

B. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to contract price.

C. Expenses due to vandalism before substantial completion shall be borne by Contractor.

D. Owner will maintain turf and planting areas during warranty period, so as not to hamper proper operation of irrigation system.
E. Guarantee/warranty applies to originally installed materials and equipment, and
replacements made during guarantee/warranty period.

PART 2 MATERIALS

2.1 QUALITY

Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

A. Use specified equipment, or pre-approved equal. Alternative equipment must be
approved by Owner’s Representative prior to bidding. Changes and associated design
costs to accommodate alternative equipment are Contractor’s responsibility.

B. Pipe sizes referenced in the construction documents are minimum sizes, and may be
increased at Contractor’s option.

2.3 SLEEVING

A. Provide sleeve beneath hardscape for irrigation pipe. Provide separate sleeve beneath
hardscape for wiring bundle.

B. Provide PVC Class 200 pipe with solvent welded joints for sleeving material beneath
hardscape unless otherwise indicated on plans.

C. Sleeve sizing: A minimum of twice the nominal diameter of carrier pipe or wiring bundle,
or as indicated on drawings.

2.4 PIPE AND FITTINGS

A. PVC Mainline Pipe and Fittings:
1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation
Foundation (NSF) approved pipe, extruded from material meeting requirements
of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral
belled end.
2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and
tolerances established by ASTM Standard D2241.
3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for
mainline pipe with nominal diameter greater than or equal to 3-inches. Use
Gasketed pipe joints conforming to “Laboratory Qualifying Tests” section of
ASTM D3139. Use gasket material conforming to ASTM F477. Use Harco or
approved equal rubber-gasketed deep bell ductile iron fittings conforming to
ASTM A-536 and ASTM F-477. Use lubricant approved by pipe manufacturer.
4. Use solvent weld pipe for mainline pipe with nominal diameter less than 3-inches.
Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM
Standards D2466 and D1784. Use primer approved by pipe manufacturer. Use
solvent cement conforming to ASTM Standard D2564.
B. HDPE Mainline Pipe and Fittings:

1. Use high density, extra high molecular weight polyethylene pipe (HDPE), extruded from material meeting the specifications of cell classification on PE 345434C, ASTM standard D 3350, SDR 11, rated at 160 PSI, conforming to the dimensions and tolerances established by ASTM F 714 for mainline pipe.

2. Join pipe lengths using butt-fusion technique as recommended by pipe manufacturer. Join HDPE to dissimilar pipe materials using HDPE (butt-fusion) x flange adapter with ductile iron back-up ring.

C. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end suitable for solvent welding.

2. Use Class 160, SDR-26, rated at 160 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in cases where small nominal diameters are not manufactured in Class 160.

Use solvent weld pipe for lateral pipe. Use UV radiation resistant Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

D. Specialized Pipe and Fittings:

1. Use stainless steel fasteners and rubber gaskets for flanged connections.

2. Use PVC Schedule 80 nipples and PVC Schedule 40 threaded fittings for threaded pipe connections.

3. Joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by pipe fitting or valve manufacturer.

E. Thrust Blocks:

1. Use 3,000 PSI concrete. Use commercially pre-mixed concrete unless written approval is provided by Owner's Representative prior to construction.

2. Use 2 mil plastic protective sheeting.

3. Use No. 4 Rebar.

F. Joint Restraint Harness:

1. Provide joint restraint harness components as recommended by pipe and fitting manufacturer and in accordance with accepted industry practices. For joint restraints on PVC pipe applications, use restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536-80 and ASTM F1674-96.

2. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials which are zinc plated or galvanized.
2.5 MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly: as presented in drawings and installation details.

B. Quick Coupling Valve Assembly: as presented in drawings and installation details.

C. Air Vacuum Relief Valve Assembly: as presented in drawings and installation details.

2.6 SPRINKLER IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: as presented in drawings and installation details.

B. Sprinkler Assembly: as presented in drawings and installation details.

2.7 DRIP IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Drip Laterals: as presented in drawings and installation details.

2.8 CONTROL SYSTEM COMPONENTS

A. Communication Cable:
   1. Use Paige P7162D-A communication cable designed for direct burial, as recommended by control system manufacturer.
   2. Splices: Use 3M #SLic with 3M “Insulation Displacement Connectors” (316IR or UR-2), Ranger Serviseal Connectors, or approved equal, as recommended by central control system manufacturer.
   3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
   4. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

B. Low Voltage Control Wire:
   1. Use American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare control wires from the controller assembly to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for common ground wire and spare common wires from controller assembly to each remote control valve or stub-out location.
   2. Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of color different from that of active control wire. Wire color shall be continuous over entire length. Color: Use continuous color for wire jacket over entire length. Install low voltage wires using the following color coding:
- Control wires: Red
- Common wires: White
- Spare control wires: Black
- Spare common wires: Yellow


4. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.

5. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

C. Existing Control Wire:
   1. It is assumed that existing low-voltage control wire between existing controller and point-of-connections is in workable condition. Report concerns regarding existing control wire in writing to engineer prior to renovation or construction.

2.9 OTHER COMPONENTS

A. Tools and Spare Parts: Furnish operating keys, servicing tools, test equipment, spare parts and other items indicated in drawings and specifications.

B. Other Materials: Provide other materials or equipment shown on drawings or installation details that are part of irrigation system, even though items may not have been referenced in specifications.

PART 3 EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Contractor will be held responsible for coordination between landscape and irrigation system installation. Landscape material locations shown on the Landscape Plan shall take precedence over the irrigation system equipment locations. If irrigation equipment is installed in conflict with the landscape material locations shown on the Landscape Plan, the Contractor will be required to relocate the irrigation equipment, as necessary, at Contractor's expense.

B. Contractor shall field verify the static pressure at the project site, prior to commencing work or ordering irrigation materials, and submit findings, in writing, to Owner’s Representative. If Contractor fails to verify static water pressure prior to commencing work or ordering irrigation materials, Contractor shall assume responsibility for all costs required to make system operational and the costs required to replace any damaged landscape material. Damage shall include all required material costs, design costs and plant replacement costs.
C. Examine areas and conditions under which Work of this Section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.

1. Grading operations, with the exception of final grading, shall be completed and approved by Owner before staking or installation of any irrigation system begins.

D. Site Inspections:

1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities in writing to Owner's Representative prior to beginning work.
2. Commencement of work implies acceptance of existing site conditions.

E. Utility Locates ("Call Before You Dig"):

1. Arrange and coordinate Utility Locates with local authorities prior to construction.
2. Repair underground utilities that are damaged during construction. Make repairs at no additional cost to contract price.

3.2 LAYOUT OF WORK

A. Staking Shall Occur as Follows:

1. Items staked include: pipe, sleeves, and isolation valves. Staking shall occur as follows: Mark, with powdered line, routing of pressure supply line and valves. Contact Owner’s Representative 48 hours in advance and request review of staking. Owner’s Representative will advise installer as to the amount of staking to be prepared. Owner’s Representative will review staking and direct changes if required. Review does not relieve installer from problems due to improper placement of equipment after staking.

2. If Project has significant topography, freeform planting beds, or other amenities which could require alteration of irrigation equipment layout as deemed necessary by Owner’s Representative, do not install irrigation equipment in these areas until Owner’s Representative has reviewed equipment staking.

B. Install irrigation components inside of project property lines.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

A. Excavate and install pipes at minimum cover indicated in drawings or specifications. Excavate trenches at appropriate width for connections and fittings.

B. Minimum cover (distance from top of pipe or control wire to finish grade):

1. Mainline pipe (diameter 6-inches and greater): 30-inches to top of pipe.
2. Mainline pipe (diameter 4-inches and less): 24-inches to top of pipe.
3. Electrical conduit: 24-inches to top of pipe.
4. Control wire: 2-inches offset from bottom of mainline pipe.
5. Communication cable: 2-inches offset from bottom of mainline pipe.

C. Existing Tree Clearance: Refer to Section 1 of this specification.

D. Backfill only after lines have been reviewed and tested.
E. Excavated material is generally satisfactory for backfill. Use backfill free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum diameter. Remove material not suitable for backfill. Use backfill free of sharp objects next to pipe. Backfill buried pipe in either of the following manners:
2. Backfill trench by depositing backfill material equally on both sides of pipe in 6-inch layers and compacting to density of surrounding soil.

F. Enclose pipe and wiring beneath roadways and hardscapes in separate sleeves. Minimum compaction of backfill for sleeves shall be 95 percent Standard Proctor Density, ASTM D698-78. Use of water for compaction around sleeves, "puddling", will not be permitted.

G. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades.

H. Contact Owner’s Representative for trench depth adjustments where utilities conflict with irrigation trenching and pipe work.

I. Piping Under Paving:
1. Provide for a minimum cover of 18 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete or concrete paving.
2. Piping located under areas where asphalt or concrete paving will be installed shall be bedded with sand (a layer 6" below pipe and 6" above pipe).
3. Compact backfill material in 6" lifts at 90% maximum density determined in accordance with ASTM D155-7 using manual or mechanical tamping devices.
4. Set in place, cap, and pressure test all piping under paving, in presence of Owner prior to backfilling and paving operations.
5. Piping under existing walks or concrete pavement shall be done by jacking, boring, or hydraulic driving, but where cutting or breaking of walks and/or concrete is necessary, it shall be done and replaced at no cost to Owner. Obtain permission to cut or break walks and/or concrete from Owner.

3.4 SLEEVING AND BORING

A. Provide sleeving at depth that permits encased pipe or wiring to remain at specified burial depth.

B. Install sleeving under asphalt paving and concrete walks, prior to concreting and paving operations, to accommodate piping and wiring. Compact backfill around sleeves to 95% Modified Proctor Density within 2% of optimum moisture content in accordance with STM D1557.

C. Extend sleeve ends twelve inches beyond edge of hardscape. Cap sleeve ends and mark with stakes. Provide rope or wire through sleeve and secure to stake at surface grade at each end for future sleeve location.
3.5 ASSEMBLING PIPE AND FITTINGS

A. General:
1. Keep pipe free from dirt and debris. Cut pipe ends square, debur and clean as recommended by manufacturer.
2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. Trenches may be curved to change direction or avoid obstructions within limits of the curvature of pipe. Curvature results from bending of pipe lengths. Do not exceed pipe and fitting manufacturer’s allowable deflection at joints. Minimum radius of curvature and offset per 20-foot length of pipe-by-pipe size are shown in following table.

<table>
<thead>
<tr>
<th>SIZE</th>
<th>RADIUS</th>
<th>OFFSET PER 20' LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½&quot;</td>
<td>25'</td>
<td>7'-8&quot;</td>
</tr>
<tr>
<td>2&quot;</td>
<td>25'</td>
<td>7'-8&quot;</td>
</tr>
<tr>
<td>2 ½&quot;</td>
<td>100'</td>
<td>1'-11&quot;</td>
</tr>
<tr>
<td>3&quot;</td>
<td>100'</td>
<td>1'-11&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
<td>100'</td>
<td>1'-11&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>150'</td>
<td>1'-4&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>200'</td>
<td>1'-0&quot;</td>
</tr>
</tbody>
</table>

B. Mainline Pipe and Fittings:
1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Rubber-Gasketed Pipe:
   a. Use pipe lubricant. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
3. PVC Solvent Weld Pipe:
   a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
   b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
   c. Snake pipe from side to side within trench.
4. HDPE Mainline Pipe:
   a. Join pipe lengths using butt-susion technique as recommended by pipe manufacturer.
   b. Join HDPE pipe to dissimilar pipe materials using HDPE (butt-fusion) x flange adapter with ductile iron back up ring. Provide flanged transition fitting as required for connection to dissimilar pipe material.
5. Fittings:
   a. Use of cross type fittings is not permitted.
b. Do not strike ductile iron fittings with metallic tools. Cushion blows with wood block or similar shock absorber.

C. Lateral Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Solvent Weld Pipe:
   a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
   b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
   c. Snake pipe from side to side within trench.
3. Fittings: Use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Flanged connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
2. PVC Threaded Connections:
   a. Use only factory-formed threads. Field-cut threads are not permitted.
   b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
   c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

E. Thrust Blocks:

1. Use thrust blocks for fittings on pipe greater than or equal to 3-inch diameter, or any diameter of rubber gasketed pipe.
2. Size, orient, and place cast-in-place concrete against undisturbed soil as shown on installation details.
3. Wrap fitting or component with plastic to protect bolts, joint, gasket and fitting from concrete. Do not bury fitting or component in concrete.
4. Commercially delivered concrete requires a 3,000 PSI mix.
5. If pre-mix bags are used, mix per manufacturer’s recommendations (maximum 1 gallon of water to 80-pound bag of pre-mix).
6. Contractor is responsible for performing a slump test (minimum of 2-inches to a maximum of 4-inches) if requested by Owner’s Representative.

F. Joint Restraint Harness:

1. Use on pipe greater than or equal to 3-inch diameter or any diameter of rubber gasketed pipe. Use a joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow use of thrust blocks, or where extra support is required to retain fitting or joint.
3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Isolation Gate Valve Assembly: Provide where indicated on drawings. Install at least 12-inches from and align with adjacent walls or edges of paved areas. Brand “GV” on valve box lid in 2-inch high letters.

B. Quick Coupling Valve Assembly: Provide where indicated on drawings. Brand “QC” on valve box lid in 2-inch high letters.

C. Air Vacuum Relief Valve Assembly: Provide where indicated on drawings. Brand “AV” on valve box lid in 2-inch high letters.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:
   1. Flush mainline before installation of RCV assembly.
   2. Provide where indicated on drawings. Use wire connectors and waterproof sealant to connect control wires to remote control valve wires. Provide connectors and sealant per manufacturer’s recommendations.
   3. Provide only one RCV to a valve box. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12-inches between valve boxes. Brand controller letter and station number on valve box lid in 2-inch high letters.
   4. Attach ID tag with controller station number to control wiring.

B. Sprinkler Assembly:
   1. Flush lateral pipe before installing sprinkler assembly.
   2. Provide per installation details at locations shown on drawings.
   3. Locate rotary sprinklers 6-inches from adjacent walls, fences, or edges of paved areas.
   4. Install sprinklers perpendicular to finish grade.
   5. Provide appropriate nozzle or adjust arc of coverage of each sprinkler for best performance and uniform coverage.
   6. Adjust radius of throw of each sprinkler for best performance and uniform coverage.
3.8 INSTALLATION OF DRIP IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Drip Laterals:

1. Flush mainline pipe before installing RCV assembly.

2. Locate as shown on drawings. Connect control wires to remote control valve wires using wire connectors and waterproof sealant. Provide connectors and sealant per manufacturer's recommendations.

3. Provide only one RCV to valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Align grouped valve boxes in uniform patterns. Allow at least 12-inches between valve boxes. Brand controller letter and station number on valve box lid in 2-inch high letters.


3.9 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Communication Cable:

1. Route cable as directed on plans. Install with minimum number of field splices.

2. Install cable using open trenches. Use of vibratory plow is not permitted.

3. Carefully backfill around cable to avoid damage to wire insulation or wire connectors.

4. If cable must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate splices in housing afforded by other control system components or separate 12-inch standard valve box. Coil 3-feet of cable in valve box.

5. Install cable parallel with and below mainline pipe unless noted otherwise on plans.

6. Provide continuous run of warning tape above cable. Install warning tape six inches above cable. Encase cable within electrical conduit where not installed in common trench with mainline pipe.

B. Low Voltage Control Wire:

1. Bundle control wires where two or more are in same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals. Do not tape wires together where contained within sleeving or conduit.

2. Provide 24-inch excess length of wire in 8-inch diameter loop at each 90-degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tape or tie wiring loop. Coil 30-inch length of wire within each remote control valve box.

3. Install common ground wire and one control wire for each remote control valve. Multiple valves on single control wire are not permitted.

4. If control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per manufacturer's instructions. Locate splice in valve box that contains irrigation valve assembly, or in separate 10-inch round valve box. Use same procedure for connection to valves as for in-line splices.

5. Install wire parallel with and below mainline pipe unless noted otherwise on plans.

6. Install wire using open trenches. Use of vibratory plow is not permitted.
7. Encase wiring within electrical conduit where installed above grade.

3.10 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts: Prior to Review at completion of construction, supply to Owner operating keys, servicing tools, spare parts, test equipment, and other items indicated in General Notes on the drawings.

B. Other Materials: Provide other materials or equipment shown on drawings or installation details that are part of irrigation system, even though items may not have been referenced in specifications.

3.11 PROJECT RECORD (AS-BUILT) DRAWINGS

A. At onset of irrigation installation secure mylar sepias of original irrigation design from Owner. At the end of every day, revise prints for Work accomplished that day in red ink. As-built sepias shall be brought up-to-date at the close of the working day every Friday by a qualified drafts person. A print of record plan(s) shall be available at Project Site. Indicate zoning changes on weekly as-built drawings. Indicate non-pressure piping changes on as-builds. Upon completion of Project, submit for review, prior to final acceptance, final set of as-built mylar sepias. Dimensions, from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures), location of following items:
   1. Connection to existing water lines.
   2. Routing of sprinkler pressure lines (dimension maximum 100 feet along routing).
   3. Quick coupling valves.
   4. Control wire routing if not with pressure mainline.
   5. All gate valves.
   6. Other related equipment as directed.

B. Record pipe and wiring network alterations on a daily basis. Record work that is installed differently than shown on construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each sleeve end, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within valve box.

C. Owners Representative will not certify any pay request submitted by the Contractor if the as-built drawings are not current, and processing of pay request will not occur until as-builds are updated.

3.12 WINTERIZATION AND SPRING START-UP

A. Winterize irrigation system in fall following completion, or partial completion, of irrigation system construction within 3 days notification by the Owner. Start-up irrigation system in spring following completion, or partial completion, of irrigation system construction within 3 days notification by Owner. Repair any damage caused in improper winterization at no additional cost to Owner. Coordinate winterization and start-up with landscape maintenance personnel.
3.13 MAINTENANCE

A. Maintain irrigation system for a duration of 30 calendar days from formal written acceptance by Owner’s Representative. Make periodic examinations and adjustments to irrigation system components in order to achieve the most desirable application of water.

B. Following completion of Contractor’s maintenance period, Owner will be responsible for maintaining system in working order during remainder of guarantee/warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after landscape maintenance operation.

3.14 CLEANING

A. Maintain continuous cleaning operation throughout duration of work. Dispose of, off-site at no additional cost to Owner, all trash or debris generated by installation of irrigation system. Remove from site machinery, tools, excess materials, and rubbish upon completion of work.

END OF SECTION